AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 3, No. 22. WEEKLY. | NEW YORK, MAY 29, 1880. | $3.00 per Annum. SINGLE COPIES, 6 CENTS.

Self-Clamping Paper Cutting Machines.

The main peculiarity of the newly designed paper cutting machines, illustrated upon this page, is what is known as the "undercut." The knife and knife-bar are underneath the table, the movement while cutting being upwards against the clamp which holds the cutting board. In other paper cutting machines, the material to be cut is placed under, instead of over, the knife. The principle embodied in the machines herewith represented, gives a self-clamping arrangement, holding the paper, it is claimed, so that a perfectly true cut can be relied upon. The power is so directly applied that there are no breakages.

This principle has been thoroughly tested by two or three years' use of machines similar to those under review. A new friction clutch has been applied to these machines, which enables the operator to stop the machine at any point, immediately throwing out the clutch, either by foot or hand.

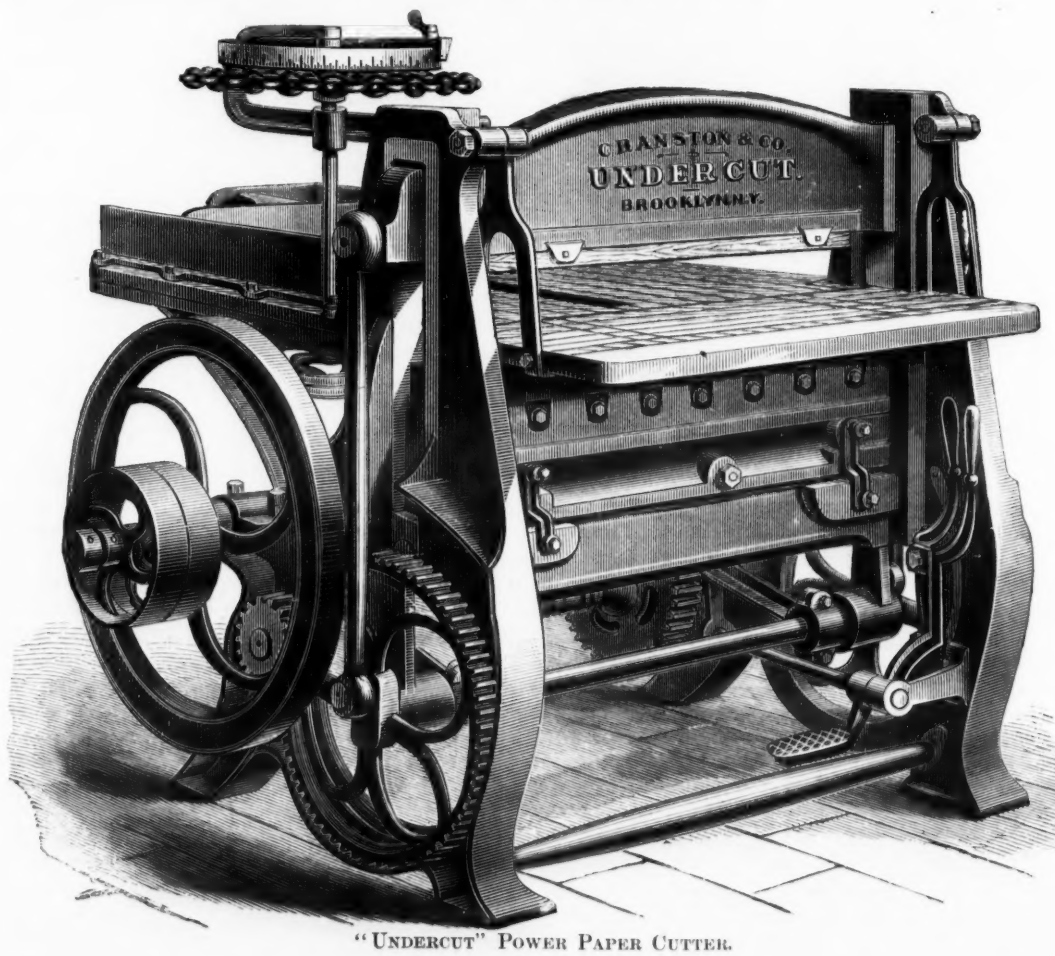
The accuracy and rapidity with which these machines perform their work are distinguishing features. The clamping being in the opposite direction to the clamping of the knife, the paper is so securely held that it is next to impossible for it to move, and the knife moving in a slotted frame and against the table is so held and supported through its whole length, that there is virtually no spring to it, thus insuring a perfectly true cut.

As the operation of clamping and cutting are simultaneous, no time being lost in unclamping, the saving of time is considerable over old methods and the amount of work largely increased. Owing to the fact that the movement of the knife in making the cut is upward, any grit that may be on the machine or in the paper does not accumulate on the cutting board, and the knife will therefore retain its edge for a longer period.

Another peculiarity is a fixed front gauge which is found very convenient for small work. The back gauge can be moved the whole length of the table almost instantaneously, and an indexed wheel in plain sight indicates exactly its distance from the knife. These machines also have a movable front table yielding as the cut is made to the increased thickness of the knife, as it passes through. The connecting of the knife-bar and clamp is by a simple crank and connecting rod in such a manner that all the power that is required to force the knife through the paper becomes a clamping power to hold the paper firmly in its place. The hand power lever machine is made in six sizes from 25 inch to 48 inch. All machines above 30 inches are arranged to work with two levers when making heavy cuts. The power machine is double geared and so arranged that the strain is equally divided bringing the knife and clamp together perfectly true at each end.

These paper cutters are made by Cranston & Co., 79 to 85 First St., Brooklyn, E. D., N.Y.

"UNDERCUT" HAND LEVER PAPER CUTTER



"UNDERCUT" POWER PAPER CUTTER.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * Men, and especially mechanics, are always wiser and better after making some big mistake. They are in some degree insured against the mistake in the future. The best machinists it has ever been my good luck to fall in with, have been men who have gone at the trade after a long experience at something else. A man don't find out what is in him till he has wrestled with circumstances for a short lifetime.

* * * * One of the cant expressions of a narrow-headed mechanic is "Every man to his trade." Such men are very jealous of the success of any one who slips into their craft edgewise.

Some short-sighted father grabs his fourteen-year-old boy, who has never shown any loud preferences for the vocation, and shoves him by force into some trade. The boy goes at it passively, and without becoming in any degree a smart mechanic. He learns the use of tools, and regular methods of procedure in regular cases. In irregular cases he is a mere cipher, and don't count. After a term of three or four years he assumes the dignities of a journeyman. He knows what he has learned, and nothing else. He gets the lowest pay which a boss dares pay to a full-fledged workman, and that is, maybe, a trifle more than he is worth. He works on for years, but is nothing but a skilled machine which must be adjusted for every new condition. This man grumbles at the poor pay a good mechanic has to work for. Some one suggests that perhaps he is not a good mechanic, and points to real mechanics around him who, by some hocus pocus, get a great deal better pay than he does. Then this stock mechanic looks around, and indignantly protests against Smith, who has only worked half as long at the trade as he has, getting more pay than himself; and he points derisively to Jones, as a man who never did serve a time at the trade; and to Robinson, who was an apprentice a month ago.

These three men get better pay than he does, and these three men are infinitely better mechanics than he will ever be. The probabilities are, that he has struck the wrong trade, and will never be one of the best, or even ordinary elements of it. Such men are to be pitied. The only hope for them is, that they will discover some vocation which they can excel in, and will go at it. A man of middle age, who has had a long, even if unpleasant, experience in hard work in certain branches, can go at a new trade and be excellent in a month, perhaps. The manipulation of tools, the knowledge of materials, and the general routine of mechanic's work is similar in many respects.

A good marble cutter will make a better vise hand in a machine shop in one month than a printer will in two years. No mechanic ought to blush to use his own judgment in such matters, and, even after years of hard tugging, cut loose from a bondage inflicted by a short-sighted guardian, and go at something which the mature judgment of manhood tells will be successful. This mutual switching around of good men who have got into the wrong holes will finally get each man into the right place. Whenever one mechanic, good or bad, sees a man coming into his trade from some other trade he can feel justified in giving him a welcome instead of muttering "Every man to his trade."

* * * * Once in a while you hear some despondent workman say "There's the trade I ought to have gone at," and once in a while I say to such a man, go at that trade now. Forty years is none too old to go at the thing a man feels he is cut out for. Every man is entitled to a little ordinary every-day success before he dies.

* * * * Because a man after fifteen years' hard work has failed to make a tip-top blacksmith of himself, it don't follow that he won't make a good surgeon, or dentist, or executive officer in almost any business;

and there's many a good blacksmith, if they only knew it, who is trying to accomplish something as a preacher, or lawyer, or what-not. I say that "Every man to his trade," is a good motive, and I say that it is every man's privilege at any time in life to find out what his trade is.

* * * * This whole thing is brought to my mind by acquaintance with pattern-makers, and I expect every one who has had anything to do with pattern-makers has had my experience. There is not a shop in the country employing half-a-dozen pattern-makers which don't get into a pinch once in a while, and have to put a carpenter, or a cabinet-maker on pattern work to tide over a rush. After a while one of these wood butchers will come around and say he would like a steady job under instructions. He wants to quit his present trade and go at one he believes he will excel in.

He's my man every time. If you want a good pattern maker this is the kind of stuff they are made of, and it is generally a hundred per cent. better that ten-year-old stock that don't know what it was made for, and won't know for thirty years more.

There's always a foolish kick in the pattern-shop when this man goes to work. The pattern-makers want to know why this man don't stay at his trade. The answer is simple: It's because he don't want to.

This man comes with years of experience in working wood with wood tools, and with a mature mechanical judgment in the perception of things. That he ash good sense is proven by his choosing his vocation before he dies.

* * * * I know these pattern-makers like a book. There's Bob, for instance, is an old pattern-maker, and the best one I ever had anything to do with. You take your drawings to Bob and he makes the patterns. And the patterns are right too. You don't have to measure to see if there's shrinkage here, and rappage there. You don't have to find out if this core will cut through where you don't want it to, or if that core is in such form that it can't be set. You need have no anxiety about sizes, or about bosses coming in the right place, or about sharp work where you want fillets. You need not bother yourself about the matter at all.

If your drawing was right the patterns will be right, and you can order them into the foundry without any anxiety, or fussing, or wondering. It's Bob's business to make patterns which will make castings like the drawings, and he understands his business, and attends to it. He don't stand around with sharp tools and wait for instructions how to make this, how to part that, how to dowel this, where to glue that, and when to put these rapping plates on, and where to put cores, and where to draw in green sand, and all such. That's his business. Bob's a pattern-maker, and a good one, and I defy any pattern-maker to prove Bob off in any of the points of his trade. Did Bob's father kick him into the pattern-makers' trade? Not a bit of it. Bob was a steamboat carpenter, and went to pattern-making when past forty, I guess, because he saw he was the man for the trade.

* * * * Bob is one of these men who don't like to see any man come to work in a pattern shop who is not a "regular pattern-maker."

* * * * I never will let up on my admiration for the rare pattern-maker who can make good, nice, everlasting patterns when required to, but who also knows how to nail a thing together in ten minutes if you only want one casting off of the pattern.

In the small jobbing shops in scattered western towns the proprietor is generally a machinist, and the pattern maker is a man with responsibilities. If the pattern-maker is a good man, the concern may succeed, but if he is a poor stick the institution is bound to fail.

There are no draughtsmen around these shops, no lordly engineers with square roots, and cube root, and logarithms, and torsion equations, and density tables, and all such.

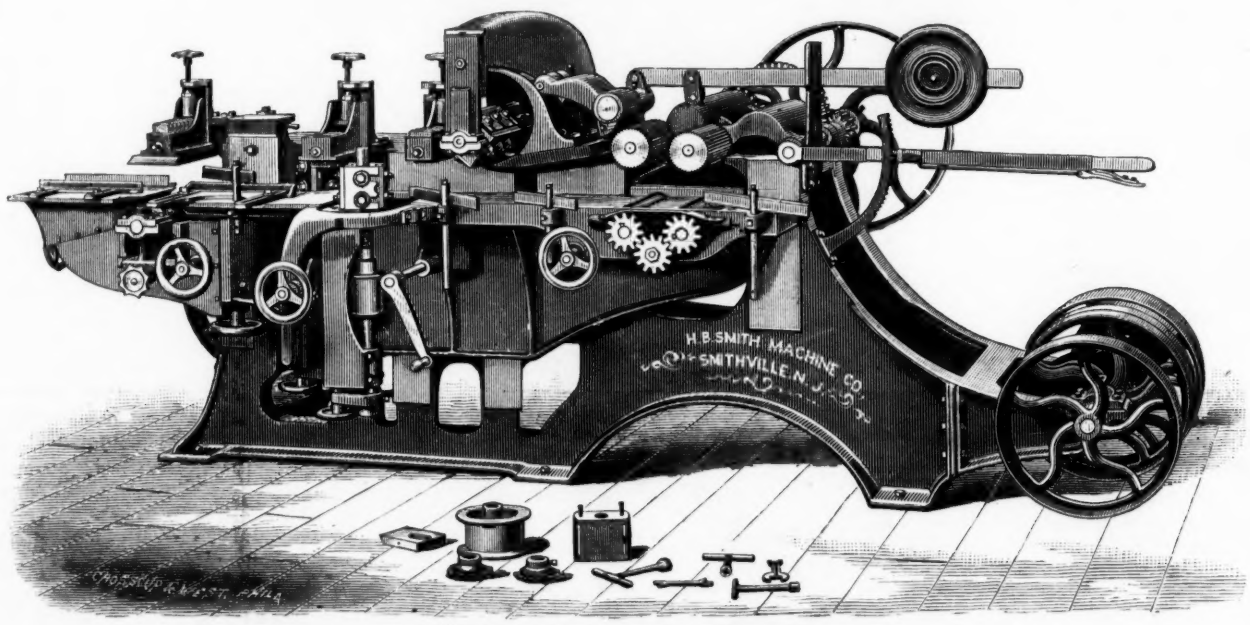
The pattern-maker is generally the one called on to furnish the high art for the establishment.

The foundries connected with these shops take off a heat of about eighteen hundred pounds once or twice a week, and about nine-tenths of the work is cast from patterns made for that heat, so you will see that this pattern-maker—he almost always works alone—has his hands full. Thursday is the casting day, and five o'clock is the hour set for the fan to be put on. Tuesday night the pattern-maker will say he is ready, and you will find him working on some pulley pattern he has been trying to add to the set for a year.

Wednesday morning the proprietor begins to think of things which must be made this heat, and repair jobs will come in a rush, and by noon Wednesday our pattern-maker will have laid that everlasting pulley pattern away, and will have mapped out a lot of patterns for the heat to-morrow, which would keep a common high toned shop full of pattern makers busy for a week. It don't seem to make any difference what comes, or how much of it, bevel gears, spur gears, odd boxes, thimble skeins, sash weights, a face-plate, a crosshead, a stop-valve, a lamp-post, a stove-grate, a dumb-bell, reaper cranks, concaves, step-plates, couplings, and what-not. He don't get any dinner or supper, maybe, and the fan-belt don't get on till six o'clock; but Friday morning he will get down that eternal pulley pattern again. He has probably put in six weeks solid time on that pulley pattern and it ain't done yet, but he has done some "odd jobs" in the meantime.

* * * * Very respectfully,

CHORDAL.



NEW TEN-INCH MOULDING MACHINE.

New Ten-Inch Moulding Machine.

The moulding machine, herewith illustrated, is of a new and improved style. Its manufacturers have aimed to embody in this machine all the best features that experience and skill could suggest. It is intended to meet the wants of car shops and large moulding establishments, and is capable of cutting any kind of moulding not exceeding ten inches in width and four inches in depth. It will also dress on four sides, flooring and sheathing, planing and matching, up to ten inches wide.

The table drops twelve inches for jointing door rails, etc., thus enabling the machine to plane on two sides timber not exceeding in dimensions 10 × 12 inches. The vertical screw for adjusting the table is operated by a horizontal shaft in the front, geared so as to gain power and is convenient of access. In addition to the support afforded by the single adjusting screw and long gibbed bearing, the table is firmly clamped to the frame near each end by two powerful screw bolts, which hold it perfectly steady in any desired position. A rigid outside bearing is provided and so arranged as to leave the upper head accessible from all points. This bearing is never disturbed while raising or lowering the table, and its position upon the shaft is not changed by adjustments of the upper headstock. Provision is made for adjusting this headstock from the front of the machine, instead of the rear, as heretofore.

That portion of the table carrying the under cylinder is vertically adjustable by means of a single screw. The under cutter is adjustable endwise and is freely accessible. The end beyond the under cutter is also adjustable. Each of the side heads are adjustable to or from the table by means of a single screw; they are also adjustable up and down, and may both be set at any desired angle.

The machine is provided with the necessary springs and the three pressure bars, one of which is placed between the upper and the outside heads. These latter are arranged with adjustable sections, adapting them for holding mouldings of any shape, or plain bars may be applied for surfacing only. All speeded shafts are of steel and run in boxes lined with the best babbitt metal. The cutter heads are all of moulded steel and slotted to carry four knives, except the under head, which is furnished with two slots only, unless otherwise ordered.

The feeding mechanism is of improved construction, consisting of two upper and two lower rolls, *all driven*, and is claimed to be the most powerful of any ever applied to a similar machine. The two upper rolls are fluted and heavily weighted. Smith's patent spur feed rolls are also furnished. Four rates of feed are provided, viz.: 20, 30, 36, and 52 feet a minute. The machine weighs about 4,500 lbs. The manufacturers are H. B. Smith Machine Co., Smithville, N. J.

A German engineer, Herr Veit, of Siegen, reports that the Haupt system of gas-firing for steam boilers is coming into use in this society. The fear having been expressed that this mode of firing would quickly destroy the boilers, he examined minutely a boiler that had been five months constantly heated in this way, and found not the least change; plates and rivets were in the same excellent condition as at the last inspection in the previous year.

The people of Shickshinny, Pa, have subscribed $30,000 toward the establishment of a nail factory in that town.

Last month 2,500 carriages were shipped from the Amesbury, Mass., shops.

Isochronous Governors.

At the April meeting of the Franklin Institute, Hugo Bilgram read a paper on "Isochronous Governors for Steam Engines," suggested by the discussion at the preceding, or March, meeting, when there appeared to be some difference of opinion as to whether governors could be made isochronous. Mr. Bilgram said that the question could, in fact, be answered both ways. After the paper had been read, a discussion of what is, or should be meant by the term "Isochronous Governor," was continued. For illustrating the difference of speaking from a purely theoretical standpoint, and speaking from observation of facts, Mr. Nystrom remarked: A cylindrical shaft turned in a good lathe, like that of Sellers' or Bement's, answers the purpose of being cylindrical, and is therefore practically so; but if the same shaft is sent to Poole's establishment in Wilmington, and subjected to treatment in his grinding machine, it will be found that the shaft is not cylindrical.

The simple pendulum which is used in clocks, is the best mechanical means we know of for keeping good time; it answers the purpose of being isochronous, and is, therefore, practically so. The simple pendulum is, however, not theoretically isochronous, for if its angle of oscillation varies, its time will also vary, punctiliously speaking. There is a pendulum, however, which is theoretically isochronous, viz., the cycloidal pendulum, the construction of which is well known. Its center of oscillation oscillates in a cycloidal arc, and is guided from its center of suspension by evolutes of the same cycloid. The cycloidal pendulum has been tried in Vienna for clocks, but did not by far give so good time as that of the simple pendulum. The cycloidal pendulum is, therefore, theoretically isochronous, but practically it is not so. The same is the case with governors which are sometimes isochronous theoretically, but not practically, and *vice versa*.

When a governor can keep the throttle-valve of a steam engine wide open whilst making a certain constant number of revolutions per minute, and can also keep the same throttle-valve nearly closed whilst making the same constant revolutions as when it was kept open, then the governor answers the purpose of being isochronous, and consequently it is practically so, omitting the small variation of velocity required for operating the valve.

The Water-wheel Governor is of this kind, and can keep the gate wide open and also nearly closed whilst making the same constant number of revolutions per minute; but a small difference of velocity is required whilst the gate is being moved up or down. The water-wheel governor is, therefore, practically isochronous.

The Parabolic Governor, such as invented by Turcot and described by Rankine, is theo retically isochronous, but practically useless.

With these considerations I submit to the good judgment of the Institute, on behalf of the waterwheel governor and all other governors which can accomplish the same purpose, that they may be granted the credit of being isochronous.

Prof. Marks said that he must protest against the use of the word isochronous as applied to governors, since the latter could not become operative until a change of speed had made it necessary for them to act.

Mr. Nystrom answered that there is nothing isochronous in this world except it be the rotation of the earth around its axis, and we

may as well, as suggested by Prof. Marks, strike out *isochronous* from the dictionary of technical terms; but he desired to retain that word for practical use.

Bits of Experience.

No. V.

BY PROF. JOHN E. SWEET.

I started some twenty years ago to invent a monkey wrench, and have been inventing it at intervals ever since. If any ardent searcher for the curious should go to the trouble of overhauling my old drawings he would find nail machines, various—composing machines, various—steam engines, various—lathes, various, and so on through a long list, and the "various" would be mostly monkey wrenches. What I wanted, or thought I wanted, was a wrench that would grip the sides of a nut like a vice when we either pulled or pushed on the handle. It was not such a very ingenious thing to invent, but when it was done there were one or two pieces more than in the old wrench, and that would never do. I thought and marked and worried, and didn't make a monkey-wrench. At this time it was concluded that I did not want what I had thought I did want; but what was actually required was a wrench to turn a finished nut without bruising the corners.

This was some years before the proposition to have standard sizes, and I adopted a standard of my own, and made the nuts to fit the solid wrenches, which varied by the common division of an inch. Then I concluded that I had it, but I hadn't. When the nuts were made a standard size, which was costly, and the wrench made a mechanical fit, the least bruise would prevent its going on, or in any case it would not go on unless brought to the exact position; besides, if it was not a tight fit, it pulled upon the corners just as bad as the monkey-wrench. Then I invented the solid wrench that would go on easy and fit perfectly. Fig. 7.

It was a good thing, a mighty good thing with a bad side to it, and the bad side was always towards London. No one but myself ever tried to use one, except he turned it the wrong way the first time he tried, and every time he used it it had a way of spoiling both the nut and itself when turned in that direction. Then another invention had to be made. This time I knew I had it dead. One edge of the handle was made nice to pull on, and the other edge sharp, so the fellow would hurt his hand if he turned the wrong way. I had one made—only one, mind you—and left it for the students to discover and try. One of them discovered it and tried it; got it on the wrong way, and it cut his hand as I had intended it should. He thought "the fellow that made it must have been a fool," and so he took it to the grindstone and ground the edge off, and there was but one of that species inflicted upon the world.

But hold on, Mr. Editor, I have not got through yet. Fig. 8 shows a wrench or a thing to turn nuts. You can turn it the wrong way all you wish and it does no harm. Neither does it turn the nut. As in all wrenches the entire strain comes on the corners of the nut, the $\frac{3}{16}''$ hook is just as good as an inch and the thing works more like a ratchet brace than a wrench. There is no taking off and putting on, but simply a back-and-forth motion of the handle which does the business. A nut can be run down a given distance in half the time, and it cannot possibly be bruised on the corners. I have designed a monkey wrench now that operates on the same plan for bolts from $\frac{3}{8}''$ to $1\frac{1}{4}''$. It is perfect in theory and will not fail in practice—due to my not making one.

Now all this is a fair sample of what many of us do; work very hard to do that which is not worth doing or what need not be done. Good case-hardened nuts will stand any kind of punishment from a monkey wrench or alligator, and although the wrench shown in Fig. 8 is quicker in its action for all ordinary work it will not come into use. The great trouble with the nut question is two-sided—outside and inside. The outsides are not of a size, and the insides are neither of a size nor of the same pitch. But if those highfalutin metric agitators do not get the start of us we will get down to something like business some time.

Some $\frac{5}{8}''$ bolts were brought the other day that actually had 11 threads to the inch, and they were made at a bolt-maker's too. They were of rough iron $\frac{1}{64}''$ too large, but a solid die brought them to size and the standard case-hardened nuts worked all right. But this standard size for bolts and nuts is not

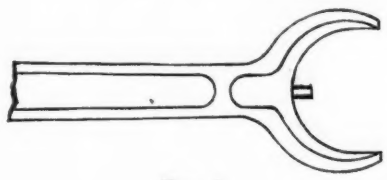


FIG. 9.

going to be established until the people find it to their interest to adopt it.

Let the machine tool-makers and engine builders who use the standard put a claim in their circulars that they use the United States Standard, and that all nuts are interchangeable and can be replaced by any firm or dealers who work or deal in standard goods. Users would soon discover the advantage and learn to order the standard work. Machine builders inflict a sort of punishment upon their customers, and the agricultural machine builders do the same to the former to an extent beyond anything they appreciate, by giving all sorts of sizes and pitches to their screw bolts. They, no doubt, say to themselves, "There is a bolt and nut that fit and have never to be changed, and what difference does it make what is the size and what the pitch of thread?" But there are bolts and nuts about every machine that have to be used and changed, and get lost and have to be replaced. Supply a shop with Sellers planers, Brown & Sharpe milling machines, Ferris & Miles drill presses, Pratt & Whitney lathes and a Corliss engine, and you have five kinds of $\frac{1}{2}''$, $\frac{5}{8}''$ and $\frac{3}{4}''$ nuts to wrestle with, and this too upon work from five first-class firms. Lose a nut from four out of five of these machines, and it means "cut a new nut in the lathe to fit," or to "put on an old nut" of a different outside diameter from those on the rest of the machine, and get an extra wrench to operate it."

I suppose there is not a tap or die maker in the country (now that the N. Y. Tap and Die Co. is dead) that will not make U. S. Standard taps and dies at the same price as others if ordered; and the same with the bolt makers. If so, the claim of cost is out of the question, and if every firm would follow the practice of Newton & Cox, of Cleveland, and state on their circulars: "All goods sent out, unless otherwise ordered, will be U. S. Standard," their customers would soon reap a benefit they are not likely to overestimate.

Fig. 9 shows a much more convenient pin wrench than the common hook sort, more convenient to put on, and turns both ways without reversing.

In scheming for the manufacture of tool steel wrenches, the following method of mortising the holes through the sliding jaw was devised, and is applicable to all rectangular mortises, such as are used in connecting rod ends, etc. First, a hole, equal in diameter to the thickness of the mortise, is drilled through the bar in a diagonal direction, as shown by dotted lines, Fig. 10. The work is then placed upon the table of a mortising or slotting machine, as represented at *A*, Fig. 11. *B* is a tool having a vertical stroke, equal to the thickness of the piece to be mortised. *C* is a stationary wedge that serves as a backing to the tool and to move the work endwise as the table of the machine is raised. Motion being given to the tool, and the bed elevated at each cut, the mortise will be squared out at one end; after which the piece is reversed and a gib put in the place of the removed metal, when the other end of the mortise is finished in the same way.

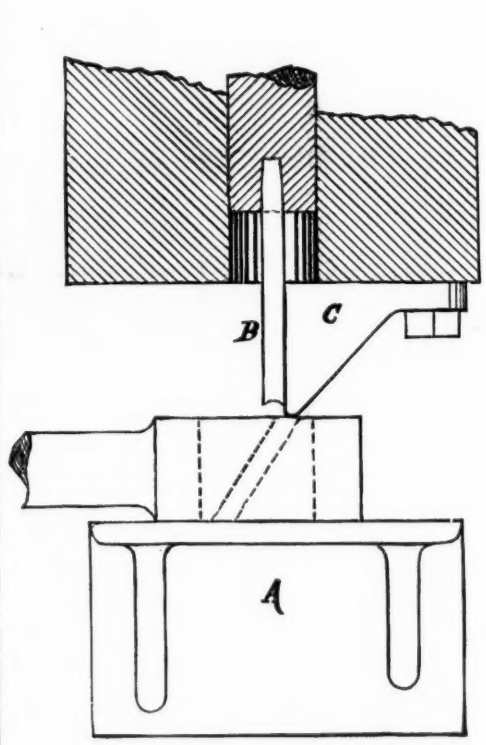


FIG. 11.

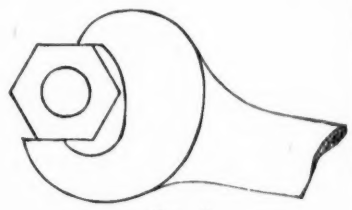


FIG. 8.

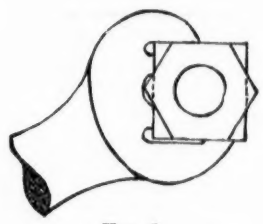


FIG. 7.

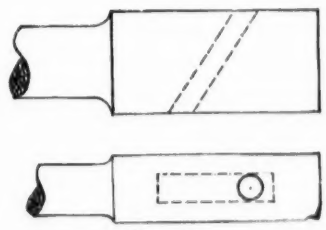


FIG. 10.

LOSS OF HEAT IN STEAM BOILERS.—Scheurer-Kestner estimates the loss of heat from the fire of a steam boiler, by radiation and conduction, at 25.5 per cent. Some writers say 40 per cent. As the loss has never been directly determined, but only estimated from the difference between other data which were imperfectly ascertained, these figures are very problematical. Ferdinand Fischer suggests experiments with combustibles of uniform composition, such as illuminating gas or petroleum, for determining calorific values and the various losses of heat. By adding the quantity of gas set free by combustion and elevated temperature, and taking account, by the help of Linde's formulas, of the specific heat which varies with the temperature, it would be possible to reach an accurate knowledge of the amount of heat transmitted through the metal to the water of the boiler.—*Dingler's Journal.*

An exhibition of manufactures will be held in September next at Buenos Ayres. This exhibition is promoted by an industrial club under the patronage of the Argentine Government, and is to be exclusively devoted to the productions of South American States. In one instance, however, an exception has been made—the exhibition is to be international as to machinery, this being a branch of industry which is of considerable importance to these States, and not yet developed there. The machines which will be admitted are to be for mining purposes, for the production of motive power in any way, for lithographic and typographic printing, manufacture of paper, for the preparation of textile fibres, for transport, civil engineering, all classes of agricultural machines, and, in short, almost all kinds of machines which can be desired in a rising country with enormous natural resources. The usual custom-house exemption is offered, and only a moderate sum charged for space. Applications for space must be made before the 31st July next, and all communications addressed to the President of the Commission, at the Secretariat of the Industrial Club at Buenos Ayres.

In the course of a discussion of a paper read before the British Institution of Mechanical Engineers at their last meeting one of the members expressed himself as follows:

The main difficulty surrounding the hardening and tempering of steel, is to account for the gradual softening as the hardened steel is slowly heated again. This difficulty has been sufficient to upset the theories of Jullien and others, but the writer thinks that the new theory offers a ready explanation. As the hardened steel is heated the pores are opened, gas is again absorbed, and, when the tempered steel is again quenched, retains the molecules at that precise distance apart by which they were separated when the quenching began.

The characteristic colors may also be explained by supposing that the opening of the pores of the metal causes changes on the surface of the steel sufficient to account for the change of color. The theory by which it is commonly sought to explain these colors is that a film of oxide, forming on the surface of the steel, plays the same part as the thin surface of a soap-bubble, or as thin films of tar or oil floating on water.

But, in the first place, the colors exhibited by steel are not iridescent, but each degree of hardness is indicated by a uniform color; and, in the next place, the hues produced by thin films are only observed in transparent bodies, and are caused by the interference of rays of light partly reflected from the upper and partly from the lower surface of the films. But oxide of iron, however thin, is never known to be transparent. Moreover, to produce a given tint, the thickness of the film must be some definite minimum quantity, or else an even multiple of that quantity; but the colors characterizing particular degress of hardness are constant, though produced under the most varying conditions of time and hardening medium; and it is difficult to conceive that the films should in all these cases always assume one of the several definite thicknesses necessary to satisfy the theory. It therefore seems more probable that a change of surface takes place, and that the colors are due to refraction rather than to interference.

Iron in Architecture.

A paper on "Iron as a Material for Architectural Construction" has been read by Mr. James Allanson Picton, F.S.A., before the Institute of British Architects. The object of the paper was to trace out the use, progress and capabilities of iron as a building material, and to inquire what influence these capabilities were likely to exercise on construction and design in the future. After reference to the wide diffusion of iron and its use in early times, the history of the metal was traced to the present time. The author commented on the little mention made of its use for architectural purposes, and pointed out that it was likely to be used to a greater extent in the future in architectural construction and design. The author could not agree with Mr. Ruskin that iron should be simply used for connecting stones together. The ultimate principle of all true architecture was to use materials within our reach in such a manner as would bring out their capabilities efficiently, for it was on this foundation that every style of architecture which had obtained a footing in the world had been based. The paper concluded by showing how in a variety of ways iron could be used, not only for the merely constructive portions of buildings, but for dome lights, galleries, entrance doorways, window balconies, &c. The engineer hitherto had enjoyed almost a monopoly of iron, but the architect, too, might put in his claim, as the material was plastic and ready to take any form, that genius and taste might suggest.

Windmills.

BY ALFRED R. WOLFF, M. E.

The writer prepared the article on "Windmills" for "Appleton's Cyclopædia of Mechanics" which has just appeared. A steadily increasing interest being evinced relative to these prime movers, it seems proper to present a portion of that paper in this journal. Moreover it is deemed advisable to preface it by a few

INTRODUCTORY REMARKS.

The action of the wind is the means of which human industry seems to have made one of the most ingenious applications for the motion of machinery. At the present time it is necessary to say but little as to the advantages which windmills afford, and the inconveniences which they overcome. Not many years ago in this country windmills were looked upon as antiquated contrivances which had been replaced by steam and other modern engines. Our rapid growth and the constantly increasing demand for practical and durable farm machinery, however, at once brought the windmill into almost general use in the United States. Unlike most other prime movers its source of energy entails no expense, being a free gift of nature, and differs from water power in not requiring storing up and directing of its course. The windmill as now constructed in America demands very little attention and care on the part of the owner, the proper lubrication of the journals being the only thing to be attended to; and by use of self-oiling cups, the whole work of running the mill can be reduced to filling of the cups about once a month.

The strong objection urged against windmills is the uncertainty of the motive power, but this is often exaggerated. Undoubtedly there are days in the year when scarcely any wind is perceptible, still 8 to 10 hours may be regarded as the average number per day that the wind blows strong enough to run a mill. It would be inconsiderate, except in particularly favored situations, to think of erecting a windmill to drive a small machine shop, or to accomplish any work which necessarily required a constant source of power; but whenever the nature of the work allows of its being suspended during a calm, and whenever the work done can be stored, as in pumping water for a variety of purposes, nothing surpasses the windmill as prime mover for cheapness of running expenses, for adaptability and beauty. A brief reference to the usages to which windmills are put should suffice: Dry lands are irrigated; and in many cases water is supplied to manufacturing establishments of many kinds and to the upper stories of dwellings when the pressure in the reservoir is not sufficient to do so. They are used all over the country for pumping water for railway water supply; power is furnished for shelling corn, cutting feed and for other work done on a large farm, as well as for sawmills; to say nothing of the many miscellaneous purposes for which they serve.

Windmills can be divided into two general classes according to the inclination of the shaft: 1. Horizontal mills, in which sails are so placed as to turn by the impulse of the wind in a horizontal plane, and hence about an axis exactly vertical; and, 2. Vertical mills, in which the sails turn in a nearly vertical plane, i. e., about an axis nearly horizontal.

HORIZONTAL WINDMILLS.—On account of the many disadvantages connected with the horizontal windmill, it is but seldom brought into use, being employed only in situations in which the height of the vertical sails would be objectionable, and this is liable to occur only in extraordinary cases. In this kind of mill six or more sails, consisting of plane boards, are set upright upon horizontal arms resting upon a tower and attached to a vertical axis, passing through the tower at its middle part. If the sails are fixed in position, they are set obliquely to the direction in which the wind will strike them. Outside of the whole is then placed a screen or cylindrical arrangement of boards intended to revolve, the boards being set obliquely and in planes lying in opposite courses to those of the sails. The result is, from whatever direction the wind may blow against the tower, it is always admitted by the outer boards to act on the sails most freely in that half of the side it strikes, or from which the sails are turning away, and it is partly, though by no means entirely, broken from the sails which in the other quadrant of the side are approaching the middle line.

The great objections to the horizontal windmill are: first, that only one or two sails can be effectually acted upon at the same moment; and, secondly, that the sails move in a medium of nearly the same density as that by which they are impelled, and that great resistance is offered to those sails which are approaching the middle. Hence with a like area of sails the power of the horizontal is always much less than that of the vertical mill. Smeaton estimated the former at one-tenth only of the latter; but Sir David Brewster, showing that in this he overlooked the loss in vertical mills of one component of the wind's pressure, concluded that the ratio is no less than 1 : 3 or 4.

Wind as Motive Power.—When the density of air is uniform throughout, the atmosphere remains at rest; but, as soon as this equilibrium is destroyed, a movement results which takes the name of wind. If in one part of the atmosphere the air becomes more dense, it rushes toward that part whose density is less, in the same manner that the air compressed in a pair of bellows escapes by its orifice. These currents of air are caused directly or indirectly by differences of temperature at different times and localities, giving rise to changes of density and varying the production and condensation of watery vapor. The variations in the velocity and pressure of the wind are considerable even within a brief time, and sometimes sudden and extreme. Winds of immense velocity and pressure are on record.

The tables from which the pressure corresponding to a given velocity of wind is generally obtained are not trustworthy, as they do not take into account the effect of temperature. The writer was the first to compute a table in which the effect of temperature received its due consideration, and of which the one below is a summary.

In making these computations attention was paid to the facts that the pressure depends upon both the velocity and the density of the air, and that this density depends upon the temperature, the barometric pressure, and the pressure due to the motion of the air. This table is for the average height of barometer, and for any other barometric pressure the figures in the table must simply be multiplied by the ratio of this barometric pressure reduced to its value for temperature of air (32° F.) to 2116.5. Thus, letting p_3 = barometric pressure at any absolute temperature t, then $p = \frac{p_3 \times t}{491.4}$, and the table must be multiplied by $\frac{p}{2116.5}$.

Example.—1. Let the velocity of wind = 15 miles per hour, the barometric pressure = 14.9 lbs. per square inch (2145.6 lbs. per square foot), and the temperature of wind = 80° F. Then $p = \frac{p^3 \times t}{491.4} = \frac{2145.6 \times (459.4+80)}{491.4}$ = 2355.2. From the table we find the pressure of wind corresponding to a velocity of 15 miles per hour, and at a temperature of 80° F., to be equal to 1.029670. This quantity must be multiplied by $\frac{p}{2116.5} = \frac{2355.2}{2116.5}$. Therefore the pressure of wind corresponding to a velocity of 15 miles per hour, barometric pressure 14.9 lbs. per square inch, and temperature 80° F. equals $\frac{1.029670 \times 2355.2}{2116.5}$ = 1.145797 lbs. per square foot of plane surface.

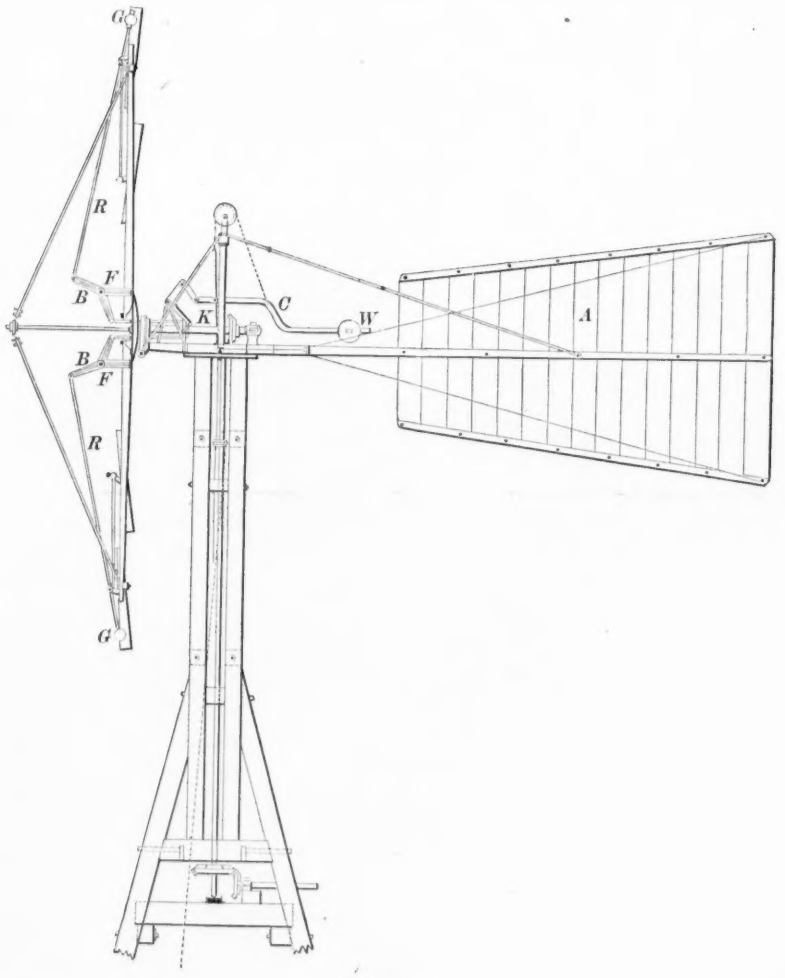


FIG. 1.

American windmills differ from those of European construction essentially in the form of wheel receiving the impulse of the wind. There are two methods in operation to regulate the extent of surface offered to the wind, viz., that of the centrifugal governor, and that of a "side vane," which is nearly in the plane of and directly behind the wheel, and attached to the bearing of the shaft. The latter, the more recent method, has given great satisfaction, while the former answers well when care is taken in the design that the momentum of the moving parts is properly counterbalanced.

CONSTRUCTION OF WINDMILLS.

Vane Governor Mills.—The construction of a Corcoran mill, having a solid wind wheel 12 ft. in diameter and side vane regulation, is represented in Fig. 2. The parts are as follows: wind-wheel, *I J K;* side-vane, *N;* flexible rudder, *M;* weighted lever, 26; connecting link, 10; slide, 24—all concentrated in iron frame 1. 17 is the supporting piece, faced on top and bored out to receive the frame 1, having a flange on top to hold lubricating compound, and being secured to the mast by four bolts. A flange also extends half way over the top of the mast. At 18 is an additional support bored out to fit 1, and secured to the post by two bolts. The main frame of the mill consists of a piece of hydraulic tubing, with a bearing to support the wind-wheel shaft, resting on an anti-friction washer; it is held in its place by a cap, 16. The object of this tubing coming down the mast as far as the windmill arm *I* is to give the main frame of the windmill equal leverage, with the strain brought upon the arm, and thereby prevent any rocking motion of the mill on the mast in unsteady winds. At 27 is the rudder-bar, and at 28 are the truss-rods, which support the rudder-vane. At 10 is a wrought-iron connecting link with ends babbitted to fit pins on the crank-wheel and slide. 26 is a wrought-iron lever, bolted to the piece 19, which works on a stud-pin on the rear of the frame. The chain 35 is connected to the stop-rod 25, which is secured to a small lever on the mast near the ground. By bearing down on the lever the wheel is brought around parallel with the rudder, thus presenting only the ends of the slats to the wind. The arms *I* are bolted to a center-piece 4, as shown. The wind-wheel is of the "rosette" pattern, and runs independent of any other part of the machine. In high winds, the increased pressure on the independent side-vane, *N*, causes the wind-wheel gradually to turn away from the wind, and raises the weighted lever 26. It is claimed that a uniform rate of speed is thus maintained, proportioned to the position of weight 13 on the lever.

Centrifugal Governor Mills.—A form of rosette wheel of the centrifugal-governor type is represented in Fig. 1. The wind-wheel consists of radial arms bolted to a cast-iron center or hub. Upon these arms are hung fan-like sections made of thin slats of wood, which in the inner sections are set at an angle of 45°, and in the other sections at an angle of 35° with the plane of the wheel, the variation being made to allow for the difference in velocity, on account of greater or less distance from the center of the wheel. Fig. 1 also shows a portion of the wind-wheel, consisting of the central hub to which are affixed the radial arms. Upon these are hung by boxes and adjustable gudgeons the fan sections *F F*. The section-bars are also shown in the margin, so as to exhibit the angle at which the slats are placed.

The operation of the mill is easily seen. As the wind strikes the sections, the angles at which the slats are placed allow the wind to pass them after first imparting a rotary motion to the wheel. Should the wind be so strong as to give too high a velocity to the wheel, the governing balls *G G*, acting through the rods *R R*, and the levers *B B*, will turn the sections upon their axis *F F*, so as to present a less surface to the wind; but as soon as the motion decreases, the counterweight, *W*, will draw the sections again into position to receive the wind. The speed of the mill is thus regulated, as is seen, by the reciprocal action of the governing and counterbalancing weights. The latter can be adjusted so as to vary the speed of the mill to some extent. The motion thus given to the self-regulating wind-wheel is communicated to other machinery through the horizontal shaft *K*, one end of which is sustained between friction-rollers, and the other in a babbitt-metal bearing. If the motion desired to be conveyed is rotary, it is transmitted through gearing as represented in Fig. 1. But if, as is most usual with windmills, it is desired to give reciprocating motion for pumping, a crank is fixed to the end of the shaft. The crank-pin when on its upper and lower center must be in a line perpendicular to the center of the turn-table

Table, showing Pressure and Velocity of Wind.

VELOCITY OF WIND.		PRESSURE IN POUNDS PER SQUARE FOOT OF PLANE SURFACE WHEN P = 2116.5 AND TEMPERATURE OF WIND =					
Miles per Hour	Feet per Second.	0° F.	20° F.	40° F.	60° F.	80° F.	100° F.
1	1.46⅔	.005371	.005147	.004940	.004750	.004574	.004410
2	2.93⅓	.021482	.020586	.019761	.019001	.018294	.017641
3	4.39⅓	.048335	.046318	.044465	.042751	.041166	.039694
4	5.86⅔	.085930	.082345	.079048	.076008	.073185	.070568
5	7.33⅓	.134271	.128668	.123514	.118758	.114355	.110267
6	8.80	.193354	.185287	.177867	.171017	.164675	.158784
7	10.26⅔	.263186	.252205	.242112	.232780	.224148	.216140
8	11.73⅓	.343767	.329423	.316228	.304050	.292774	.282265
9	13.20	.436283	.416945	.400243	.384828	.370555	.357305
10	14.66⅔	.537188	.514772	.494151	.475121	.457498	.441195
11	16.13⅓	.650436	.622908	.597955	.574923	.553600	.533815
12	17.60	.773645	.741357	.711656	.684244	.658865	.635301
13	19.06⅔	.908020	.870172	.835260	.803085	.773296	.745638
14	20.53⅓	1.053166	1.010206	.968770	.931449	.896879	.864814
15	22.00	1.209087	1.158616	1.112190	1.069347	1.029670	.992841
16	23.46⅔	1.375799	1.318354	1.265523	1.216763	1.171621	1.129707
17	24.93⅓	1 553273	1.488425	1.428786	1.373721	1.322751	1.275429
18	26 40	1.741556	1.668839	1.501951	1.540180	1.483066	1.429470
19	27.86⅔	1.940634	1.859596	1.785056	1.716260	1.652571	1.593439
20	29 33⅓	2.150516	2.060705	1.978095	1.901853	1.831270	1.765740
25	36.66⅔	3.362250	3.221749	3.092521	2.973261	2.862857	2.760359
30	44.00	4.845284	4.642662	4.456311	4.284344	4.125157	3.979371
35	51 33⅓	6.600829	6 324565	6.070498	5.836055	5.619046	5.417590
40	58.66⅔	8.630351	8.268791	7.936307	7.627948	7.345581	7.082012
45	66.00	10.935522	10.476877	10.055155	9.666070	9.305975	9.971746
50	73.33⅓	13.518265	12.950585	12.428668	11.947178	11.501614	11.088085
60	88.00	19.525304	18.702993	17.947145	17.250017	16.605925	16.006591
80	117.33⅓	34.981530	33.497300	32.13392	30.87715	29.71502	28.638716

and the support-casting, upon which the mill is carried on friction-rollers. From this crank motion is conveyed by a pitman with universal or ball joint to levers and rods below working the pump. On all mills below 30 ft. diameter the main or horizontal shaft is placed level; in larger mills the shaft is inclined at about 15° to the horizontal.

Fly Wheels.

BY PROF. S. W. ROBINSON,
Dept. of Mechanical Engineering, Ohio State University.

It is usually supposed by those who have made the mathematical solution of the problem of the fly wheel of steam engines, that the regulating power varies as the square of the velocity of the rim of wheel. This is because the mathematical expression, giving relation between velocity and fluctuation, seems to require the former to be squared when the latter is at the first power. But the relation between these two quantities will be found to be affected, by the conditions of other things. For instance, the velocities will require to be cubed in some comparisons, squared in others, simply proportioned in others, and even constant in others.

The statement of Mr. Charles T. Porter, in a previous number of the AMERICAN MACHINIST, that the regulating power of a fly wheel varies as the cube of the speed, may have seemed extravagant. If so, of course it will be likewise with the present statement that it may vary as the 0, 1st, 2d or 3d power. But the evidence will be better than the statement. [Mr. Porter explained in last issue that he meant "quite the reverse."—ED.]

But before going to figures, let us notice what specific meaning should apply to terms to be used. Speed, for instance, may be used in the sense of number of revolutions per second, velocity of fly wheel may be taken for velocity in feet per second of the rim of wheel along the path, or circle of the rim. Fluctuation of speed may be used in a general sense to mean irregularity. But coefficient of fluctuation of speed may be used in a general sense to mean irregularity. But coefficient of fluctuation has a definite meaning, as follows: It is the number obtained by dividing the difference between the greatest and least number of revolutions per second, occurring in a certain cycle of changes, by the average number. In case of the fly wheel of an engine, for instance, we have a series of changes of velocity or speed occurring within one revolution. If a whole revolution and no more is required for effecting all the varieties of change in velocity which occur, then this series of changes is the cycle above named. If the whole range in variety occurs in a half revolution, the same, exactly, being repeated in the other half revolution, then this half revolution makes the cycle. This would be the case in an engine with an exactly equalized valve gear, where the crank pin runs in a block, the latter sliding in a transverse straight slot in the crosshead. In this cycle of fluctuations there will, of course, be some point where the velocity of rim is greatest, and another where it is least. To illustrate: Suppose that where it is greatest the velocity of a prick-punch mark on the rim be such that, if just this velocity could be maintained constant for one second it would move 12 feet. Suppose likewise that where it is least the velocity would be 9 feet. Then the range of fluctuation is from 12 to 9, and from 9 to 12. Suppose, again, that in one minute the point moves, altogether, 600 feet, including fast and slow, the fluctuation during that time being in exact repetition, then in one second the average movement will be 10 feet. The *coefficient* of fluctuation will then be $\frac{12-9}{10}=0.3$.

This coefficient of fluctuation is an important factor in estimating fly wheels. It serves to rationalize our notions about fly wheels, and its use is well authorized both as a name of a tangible conception, and as capable of numerical expression.

The numerical value of the coefficient should be, as given by some authors, from a fortieth to a sixtieth, for the most perfect regulation, such as in factories of textile fabrics; while for ordinary uses it may be as low as a thirtieth, or even a twentieth. Suppose the latter value be taken, or $\frac{1}{20}=0.05$. The meaning is that in that part of the revolution where the velocity is greatest, it is one in twenty faster than where it is slowest. It applies to the speed as well as the feet per second. That is: in that part of the revolution where the wheel moves fastest, its speed for an instant is at the rate of one revolution in twenty faster than where it moves slowest. Suppose a wheel runs at a speed of 120 revolutions per minute: The fluctuation might be then from 118 to 124 within a single revolution, the coefficient of fluctuation being $\frac{124-118}{120}=\frac{1}{20}$, as stated.

The difference in the fluctuation for high and low speed engines, equally well regulated, is not a difference numerically, but simply in the period of time within which the fluctuation occurs. Thus suppose, for illustration, that an engine works 40 revolutions per minute with a fluctuation in each revolution from a rate of 39 to 41. Then $\frac{41-39}{40}=\frac{2}{40}=\frac{1}{20}$ the same as before. But here the time taken for making the change is 3 times as great as in the previous example. The coefficient of fluctuation then has no reference to the time the change of velocity is confined to, but is dependent entirely upon change of rate of speed.

Consider for a moment a buzz saw driven by either of the above engines, the saw giving forth a musical tone varying in pitch with the speed. Neglect the balance wheel effect of the pulleys, shafting, etc., between the saw and engine, the saw being regarded as varying in velocity exactly in proportion to the fly wheel. Then the change of pitch of musical note with either engine will be the same. The rapidity with which the changes occur will however be in accordance with the speeds of engines.

The coefficient of fluctuation may therefore be taken as a sort of unit, by means of which we may make an intelligent comparison of the action of fly wheels in different cases. To establish a rule for comparing, which will incorporate this coefficient, we have to consider that the work developed by the engine in a half revolution varies from nothing at the dead centers to a maximum near the mid stroke, while the resistance overcome is constant, and for a stroke equal in amount. This supposes the work of each stroke to be equal. Hence, near the mid stroke the work applied will be in excess, while near the ends it will be in deficiency. The retardation during a deficiency will be equal to the acceleration during an excess. At the beginning of an excess the velocity will be least, while at the end it will be greatest. The excess of work between these points must therefore exactly account for the increase of speed. This brings the question down to where we can compare it with familiar examples of motion resulting from the action of force.

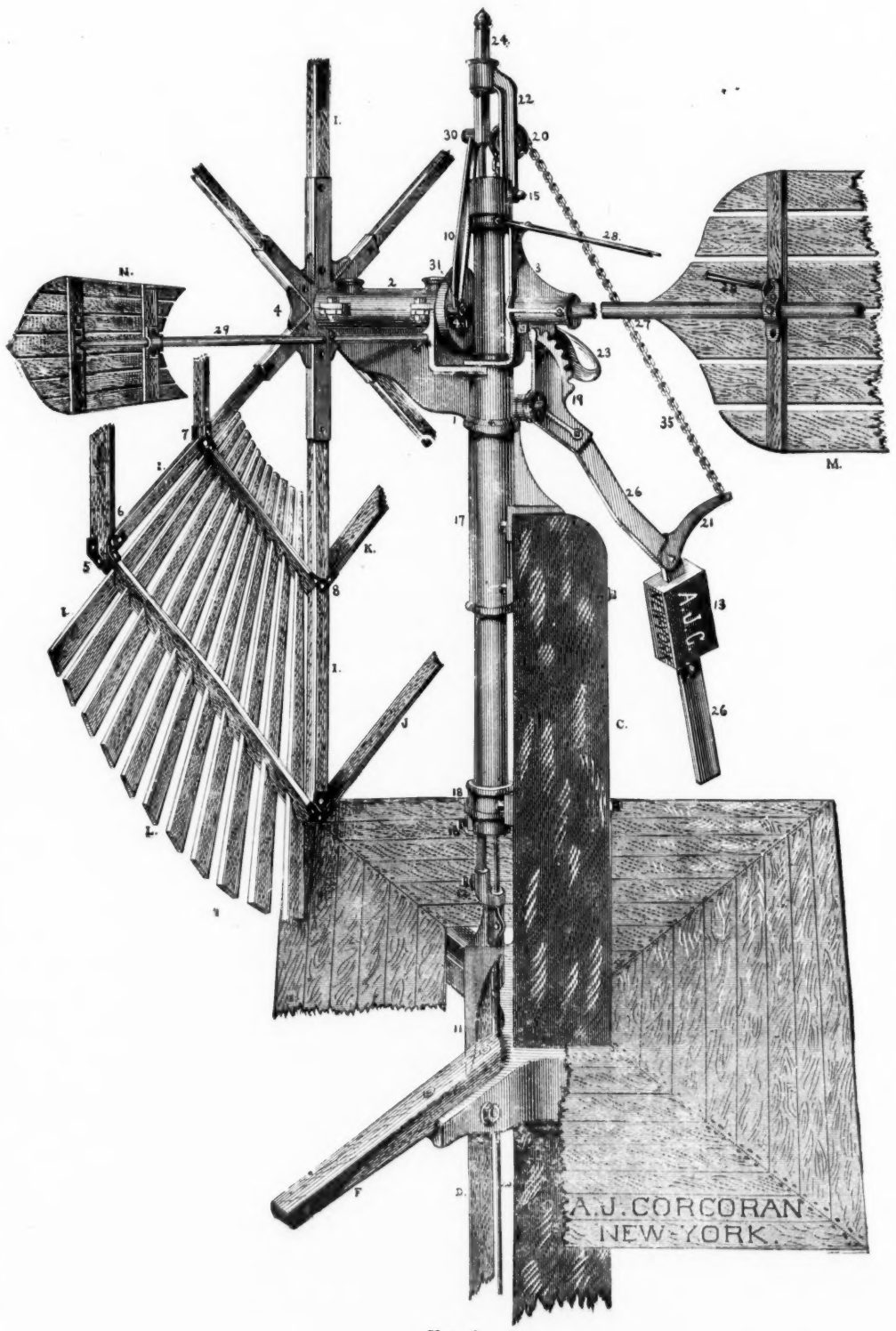


FIG. 2.

Gravity develops 100 ft. lbs. of work when 10 lbs. fall 10 ft., and if a number of experiments be made with different weights and heights, it would be found that the foot lbs. of work in each case would be equal to the product of the square of the velocity by half the mass, the mass being equal to the weight divided by about 32.2. In comparing two different falls of the same weight it will be found that the difference in foot lbs. is equal to the difference in products.

Similarly in the fly-wheel, the foot pounds of work in an excess is equal to the difference in the squares of the velocity of rim, by half its mass. Now because the difference of the squares of the velocity is equal to the simple difference multiplied by the sum, the quantity last named above can be said to be equal to the mass multiplied by the square of the average velocity, and multiplied by the quotient of the difference of velocity divided by the average velocity. The last named quotient is seen to be the coefficient of fluctuation. Hence, rule for fly-wheels. An excess in foot pounds is equal to the continued product of the mass of rim, the square of average velocity of rim, and the coefficient of fluctuation. The mass of the rim equals its net, divided by 32.2. The velocity is the number of feet the rim moves per second. To find the excess multiply the work of one stroke in foot pounds by proper value in following table.

Pressure of steam—6 atmospheres.

Cut off	.3	.5	.7	1.0 of stroke.
Value	.16	.18	.19	.17

Condensing engines.

Value	.18	.21	.22	.21

Example 1—Take an engine with cylinder 10×20 inches making 100 revolutions per minute. Coefficient of fluctuation $=\frac{1}{80}$, cutting off steam at half stroke. Pressure of steam in steam chest, 6 atmospheres or 85 pounds per square inch by steam gauge. Diameter of rim, 6 feet.

The area of piston is 78 square inches. Total initial pressure on piston 6630 pounds. Foot pounds per stroke $=6630\times\frac{20}{12}=11050$. Excess for half stroke cut off $=.18\times11050.=1989$. foot pounds.

The velocity of rim is $3\frac{1}{4}\times6\times100$ feet per minute, or 31.4 feet per second. Hence by rule

$$1989=\frac{\text{wt.}}{32.2}\times31.4\times31.4\times\tfrac{1}{80};$$

whence weight of fly-wheel $=2029$ pounds.

Though the correct value of the foot pounds per stroke is actually less for expansion engines than the product of initial pressure by stroke, still the greater convenience of this value has led to its being retained for use in the above table, the latter having been adapted to it. The table is given for the purpose of facilitating the determination of the excess.

In the balance of this article it is proposed to examine into the effect upon the weight of fly-wheels of varying the dimensions and working conditions of engine.

Example 2—Take the same length of stroke, number of revolutions per minute, steam pressure and coefficient of fluctuation as before. But let the diameters of fly-wheel and of piston vary proportionately; for example, take them half as great as in example 1, viz., 3′ and 5′′ respectively. Then excess

$$=497.=\frac{\text{wt.}}{32.2}\,\frac{15.7\times15.7}{30}$$

whence, weight of fly-wheel=2029. pounds, the same as before, though the engine has been decidedly modified, and the velocity of rim of wheel reduced one half. The engine is now doing but a fourth the work that it did in the previous example, and still the wheel requires the same weight. The comparison of these two examples does not show what is sometimes stated, viz., that the weight of wheel varies inversely as the square of the velocity of rim. The departure from this is still more strikingly shown in

Example 3.—In which let the conditions be same as in Example 2, except let the gauge pressure be quadrupled so that the engine will do the same work as in Example 1. Then, nearly the

$$\text{excess}=1989.=\frac{\text{wt.}}{32.2}\times\frac{15.7\times15.7}{30}$$

whence weight fly-wheel=8116. lbs., an almost incredible increase of weight for a smaller engine doing the same work with the same number of revolutions per second.

This, compared with Example 1, is, however, in accordance with the law stated by mathematicians that the weight of wheel varies inversely as the square of the velocity of rim; while compared with Example 2, in which the velocities are equal, no power of the velocities will express the relation between the weights.

Example 4.—Piston speed and pressure same as in Example 1, and engine similar in dimensions, but half the size—that is, cylinder 5″x10′, wheel 3′, &c. Then excess= 248.6 and velocity of rim being as in Example 1, have weight=254 pounds, only one eighth the value obtained in Example 1, though the rim velocity is here the same. The work developed is one fourth. The speed of revolutions per minute is twice as great.

Example 5.—Let the wheel have the same diameter as in Example 1, be applied to an engine doing the same work, at same steam pressure, but with half as large a cylinder. The work per stroke is only one eighth as much, and hence the number of revolutions will be eight times as great, and velocity of rim eight times as great. Hence excess

$$=248.6=\frac{\text{wt.}}{32.2}\quad\frac{251.2\times251.2}{30}$$

whence weight of wheel rim=4., or four pounds only. Compared with Example 1 the weights are inversely as the cubes of the velocities, and also of the speeds.

In all of the above examples the same coefficient of fluctuation is employed, viz., $\frac{1}{30}$. The results serve to indicate that where a fly-wheel is selected only with regard to size of engine, and without reference to the speed, or pressure it may be very far from effecting the desired degree of regulation.

If in the above examples the coefficient of fluctuation had been made to differ, instead of the weights of wheel, we should have had very great differences in the fluctuation. Suppose, for example, the weight had been taken constantly equal to 2029. Then

For example	1	2	3	4	5
Coeff. fluc=	1/30	1/30	2/15	1/120	1/15218

Hence the same weight of wheel has very different effects. The 1st and 5th examples of comparison of fluctuations employ the same wheel for engines doing same work, the difference in regulating power being simply astounding.

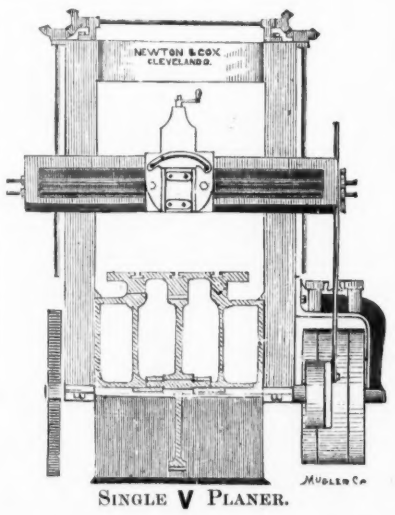
The employes of the machine shops of the Manhattan Railway Company, New York City, have been notified of an incease of their wages, which is to be made from the 1st. inst. The amount of the increase will vary according to the skill and experience of the workmen. The employes held a meeting and a vote of thanks was unanimously tendered to the company.

The West Jersey Railroad Company propose placing upon its locomotives an English patent arrangement, which is warranted to prevent the emission of sparks, smoke, and coal cinders.

Single V Iron Planer.

But few real improvements have been made in iron planers in the last ten years, and most of the prominent tool builders in the country use the same patterns, and build their planers the same way now as they did ten and fifteen years ago, while lathes, drill presses and milling machines have been greatly improved. The planer, one of the most important tools, has been left in almost its primitive state.

We illustrate herewith a cross section view of an improved iron planer made by Newton & Cox, Cleveland, O. The principal improvement consists in use of but one V while other manufacturers use two. The belt-shifting apparatus is greatly improved and simplified. One V is made and scraped to a surfacing straight edge; this is made perfectly true with itself, then the flat part is surfaced with a plate, making it a smooth plane surface. The V then serves as a guide to the carriage. This is calculated to be far preferable to the old method of two V's as all practical mechanics know that it is impossible to do perfect work on a planer. Valve-seats and bearing surfaces of fine tools always have to be scraped to a surface plate to bring them to perfect bearings. The principal cause of this is the two V's which are never perfect, and the imperfections cause the bed to "roll."



Single V Planer.

Four planers have already been built on this plan, and some time since the necessary papers to cover the improvements were filed in the patent office. There is also an improved lubricating device with the carriage that keeps it constantly oiled when in motion.

Letters from Practical Men.

BELTING.

Editor American Machinist:

In the American Machinist, No. 20, an article by Mr. Charles A. Hague calls my attention to an error in my pocket book about belting, and requests me to correct the same, whether it is a misprint or my own mistake. The error alluded to is on page 265 of my pocket book, and is not a misprint but an oversight of my own in transforming the formulas, as can be perceived by the speed appearing in the numerator instead of in the denominator where it ought to be. My attention has been called to the same error by several correspondents, and it is being corrected. Supposing the working strain of a belt to be 100 pounds per inch of width the formulas will be as follows:

$$\text{Width of belt } b=\frac{300000\ H}{d\ n\ a}.$$

$$\text{Horse-power of belt } H=\frac{b\ d\ n\ a}{300000}.$$

Example.—A leather belt is to transmit $H=75$ horse-power over a pulley $d=36$ inches in diameter, making $n=80$ revolutions per minute, and the angle of contact $a=170^{\circ}$. Required the width of the belt?

$$\text{Width of belt } b=\frac{300000\times75}{36\times170\times80}=45.96 \text{ inches.}$$

For more or less than 100 pounds working strain per inch, the width of the belt should be in the inverse proportion.

John W. Nystrom.

Philadelphia, Pa.

MANUFACTURERS AND ENGINEERS.

Editor American Machinist:

A subject which has puzzled me for many years is—why manufacturers, and others using steam power, care so litle about securing the services of a skilled and competent engineer. This is especially the case as regards stationary engineering. Of course all manufacturers say they want a good man, one that can come well recommended, and this is all right so far as it goes, but the trouble lies just here: An engineer instead of being judged by his qualifications as such, must come up to a standard of what the manufacturer calls good, which in most cases, is the amount of work that can be gotten out of him, outside of his legitimate duties, and of course to the neglect of them.

The good engineer from their standpoint, must work from 13 to 15 hours every day, and in the winter he is supposed to be early astir getting steam sufficient to have the mill well heated, so that the hands when they come will stay and work. He gets his fires in good condition, steam up, ashes wheeled out, coal in, engine cleaned and oiled, and everything in readiness for starting. After this he is expected to clean up the yard or the cellar, pack boxes, attend weighing scales, work at heating or steam pipes or anything else required. In the meantime the engine and boiler can take care of themselves, save that he is required to coal up when necessary.

There is no getting over the fact that these people do feel and think that the engineer is an encumbrance to the establishment, a useless appendage, and every dollar paid him is so much money thrown away; unless indeed, they can get what they judge to be a sufficient amount of extra work from him to compensate them for the pay he receives. Your correspondent X. D., North Plymouth, in American Machinist, No. 4, vol. 3, hits the right nail exactly on the head, and his remarks suit this locality admirably. There is one statement I will make which is applicable here, and it is—that the more work an engineer is required to perform, the less remuneration he gets. There ought to be a remedy for this state of things, because if an engineer attends to his duties faithfully (especially if he fires, which is nearly always required of him) he has no time to spare for the performance of other work, and there is always a great risk incurred in taking him from his legitimate duties.

If the protection of life and property is the great consideration, then the law should compel the employment of competent engineers. These could be obtained by appointing two or more thorough engineers as *inspectors* for the examination of candidates, they issuing certificates as first or second class, according to the ability or competency of those examined. Each application for certificate should contain the signatures of at least three engineers, vouching for the character as well as the ability of the applicant. In the case of one already licensed approving the application of an unworthy person, he might be punished by a revocation of his license or a suspension of say six months, according to the degree of guilty knowledge shown, and the inspectors should be invested with the proper authority for enforcing the decision arrived at or decided upon. This course would raise the class of American engineers to a high standard, and the certificates issued would, in every case, be a sufficient guarantee, both of the possessor's character as a man, and capability as an engineer. And further, all manufacturers and others, in fact, any one using steam power, should be obliged, under a penalty, to employ only an engineer licensed by these *inspectors*, who should, in all cases, enforce this proviso, viz.: "That an engineer shall, under no pretence whatever, be taken from his proper superintendence and care over both the boiler and engine."

As regards the examination of boilers, the inspectors should be entirely free from political or moneyed influence, in order that their examinations may be thorough, and their decisions rendered without fear or favor in condemning a boiler they judge to be of poor material or of inferior design, and their whole attention should be given to the prevention of boiler explosions. Complications arising between manufacturers and their engineers should be decided by the inspectors, who ought to be the umpires in all cases, and their decision final.

H. L. Stellwagen.

Philadelphia, Pa.

CUTTING SCREWS IN A LATHE.

Editor American Machinist:

In the American Machinist, bearing date Nov. 29, there is an article on screw cutting, with various rules for finding the various wheels. I subjoin a simple rule taken out of Templeton's *Workshop Companion:*

Divide the number of threads in a given length of the screw which is to be cut by the number of threads in the same length of the leading screw attached to the lathe; and the quotient is the ratio that the wheel on the end of the screw must bear to that on the end of the lathe spindle.

Example.—Required to find the wheels to cut seven threads to the inch, leading screw ½″ pitch.

$\frac{7}{2}\times20=70$. (20 on spindle, 70 on screw.)

When over ten or twelve threads to the inch are to be cut, proceed thus: Take any three wheels at pleasure, as those for the spindle and stud wheels; multiply the number of teeth in the spindle wheel by the ratio of the screw, and by the number of teeth in that wheel which is in contact with the wheel on the end of the screw. Divide the product by the wheel in contact with the spindle wheel, and the quotient is the wheel required on end of leading screw. By using this method, your correspondent will find no difficulty in a screw of 27 threads to the inch.

Yours truly, F. J. White.

Greymouth, New Zealand, March 21, 1880.

BEARINGS FOR MACHINERY.

Editor American Machinist:

I have read with pleasure and much interest Chordal's remarks on journals, bearings, and friction, and desire to call attention to some facts that bear directly upon this subject.

First, then, it is an indisputable fact that the fit of the surfaces is an important element in determining the weight.

The pressure of one piece that is sliding upon another, even under the more ordinary conditions, may cause the fit to be of such a nature as to partially exclude the atmosphere, and thus add to the weight of the top piece an atmospheric pressure, or weight, that must be added to the weight of the top piece itself.

In the case of Chordal's bricks the "contraction" would be such that no perceptible exclusion of air from between the surfaces would take place, hence the weight of the bricks would be the only weight which the bottom brick would sustain; but this is not always the case. For example, you have in your office a piece of steel 1½″ square, with one surface filed up, and a cast iron surface 12″×8″, also filed up, but not filed to great perfection. If you place these two filed surfaces together under the circumstances under which two such pieces may be supposed to work in a machine, you may experiment with the following results:

Lubricate the surfaces with a dozen drops of oil, and it will take about 2 lbs. to slide the bar on the plate.

Lubricate with 4 drops of oil, and it will take about 6 lbs. to slide the bar on the plate. With 3 drops of oil it will take about 8 lbs. to slide the bar. With two drops it will take more power to slide the bar on the plate, and so on until one drop of oil applied to the cast iron plate distributed all over with the hand, and then wiped off, apparently clean, and the bar will take some 16 lbs. to slide it, which is more than its own weight.

Turn the bar over so that its unfiled surface comes in contact with the plate and you will find that the amount of oil supplied makes no practical difference to the power required to slide the bar.

Of course the weight sustained by the plate has simply been increased by the at-

mospheric pressure, but the fact remains that the nature of the fit of the surfaces has influenced the friction.

This brings me to another point, which is, that if you lubricate the filed surfaces as freely as you like, and move the bar back and forth continuously for a dozen strokes, and apply a spring balance you will find that it takes more power to slide that bar under all its lubrication than it does if both surfaces are quite dry, as they will be if cleaned with alcohol. This occurs because the oil, whether in globules or not, has excluded the atmosphere to an extent producing a weight on the bar that is more than equivalent, so far as friction is concerned, to the lubrication afforded by the oil.

Practical men are right, that if a broad surface is such a fit to the base on which it slides as to induce a greater amount of unbalanced atmospheric pressure on the body than would be the case if the body were turned on edge, the friction will be increased.

Theory is also right when it says that the friction is within certain limits independent of the area of contact. But both are wrong if they take the weights of the body alone, as the weight produces friction and leaves out of calculation the nature of the fit of the surfaces in contact, or, in other words, omit to consider that the amount of atmospheric pressure due to the nature of the fit, must be added to the weight of the sliding body.

This is not merely a theoretical question, for wood-workers know that it is sometimes quite difficult to move a surfaced piece of wood on a turn-table, when the same piece of wood will move easily if turned over so that an unsurfaced side come in contact with the table.

In iron work this same fact holds good. For example, the Freeland Tool Works planed a plate weighing 24 lbs. on a planing machine that had run for 25 years; and it was so true that I could lift it from the partial vacuum between the surfaces when another plate was placed on top of it, hence there was an unbalanced atmospheric pressure on the top plate, and this produced its quota of friction so that the plate, not having its edge true, would not slide so easily on its edge as on its flat face.

The same facts apply to belts which from the atmospheric pressure, increasing with the closer "contaction" of the belt surface to the pulley, warrant the practical man's conclusion that increasing the width of a belt may, and in most cases and under proper conditions does, increase the driving power of the belt, independent of the arc of contact on the pulley, because there is more area for the atmosphere to press upon.

I reserve some remarks on the crank for journal and axle brasses for a future occasion.

JOSHUA ROSE.

New York, May 8th, 1880.

Hoisting Engines for Mines.

The accompanying illustrations represent a few of the numerous designs of hoisting engines which have been resorted to for raising ore from mines to the surface. The devices used for the purpose named are numerous, and they may all be referred to a few special classes. In prospecting in order to find the extent and value of a vein of ore, a mining expert will adopt as simple and inexpensive apparatus as possible. After the value of the mine has been ascertained and permanent works have been decided upon, the special type of hoist selected is modified in detail according to the depth and size of the ore-body and other local requirements. When ground is first broken, the work of hoisting from the shaft is performed by the aid of a windlass worked by men; as the depth increases, horses are used until a depth of 200 or 300 feet is reached, when men and horses are abandoned and a steam engine substituted. Having ascertained the value of the vein and the depth to which it will be necessary to work has become established, a permanent hoist is immediately erected. This hoist selected is always as simple as can be relied upon to do the work. It may consist of a vertical link-motion engine, connected to a drum for round rope by a set of intermediate gears. Where fuel is expensive and economy is sought, high-pressure steam is used, and advantage taken of its expansive properties. A still higher duty has been attained by using two engines connected to the same shaft, and having their cranks placed at right angles. For light loads and depth not to exceed 600 feet, the friction-geared hoist has been much used. In new districts where it is necessary to do considerable prospecting before any definite knowledge of the ore deposit can be obtained, a boiler of the locomotive type is attached to the same frames as the engine, and the whole made as light and compact as possible for moving rapidly from place to place. A similar hoist is shown in Fig. 1. The drums are not keyed on the shaft, but are brought into action by their respective clutches, which slide on feather keys, and can thus be used separately or together as desired. The brakes are set by levers placed convenient to the engineer. By the use of separate buckets in a two-compartment shaft, or, better still, by the introduction of safety cages, a much more economical system is secured for obvious reasons.

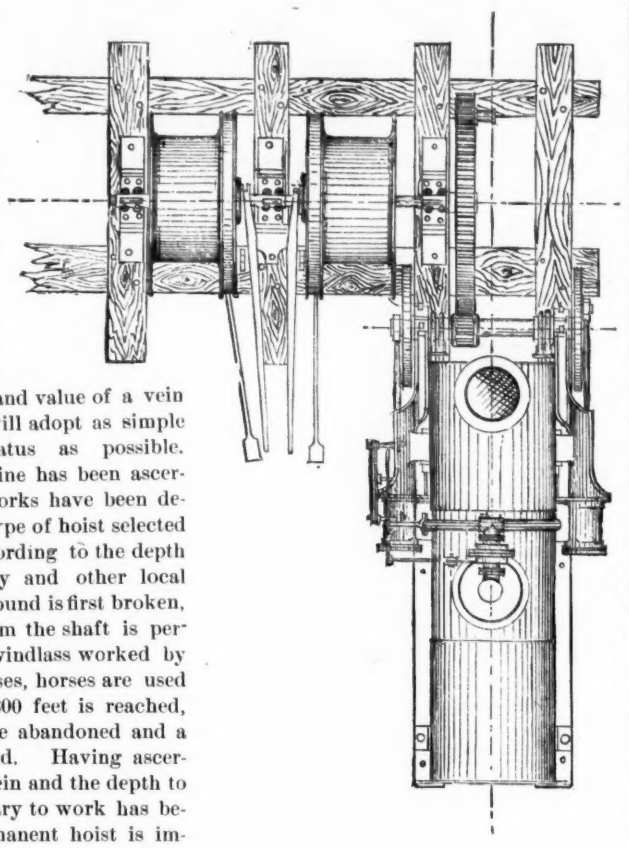


FIG. 1.

With either buckets or cages, the best results are obtained by winding the ropes on the drums in opposite directions, the one over and the other under, whereby the weight of the light descending cage is utilized in raising the loaded one that is ascending in the other compartment. Where the workings have attained a greater depth than 800 or 1,000 feet, and the ropes and attachments are increased materially in weight, larger engines are brought into requisition.

When this point has been reached, the further use of a round rope is fraught with so many difficulties, that it has been almost entirely abandoned in this country. Because of the extra wear and tear, also the necessity of larger and more expensive drums, besides many other practical objections.

Some of the objections to a round rope may be briefly stated as follows:

There are at present few, if any, instances where round ropes are in use in this country for hoisting from very deep levels. At the time they were introduced, flat ropes were looked upon with suspicion, as they had not then been tested for any great depth. Coupled with this was the fact that, for a given length and an equal load, the round rope was discovered by experiment to be the lightest, which is readily explained by the difference in their mode of construction, the strands being carefully wound together in the round rope, while in the flat rope they are simply placed parallel and secured to each other by cross-wires. This matter of the amount of dead weight hanging in the shaft was considered a very important one. Experience has developed an entirely new and more advantageous course in this country than is at present followed in England.

In following out the practice of preferring flat ropes, geared engines, as shown in Fig. 2, were first used. As will be noted, the loose pinions on the engine shaft are brought into action by their respective clutches, allowing the reels to be used separately or together. The practice of balancing the cages, by winding the rope upon the reels in opposite directions, has been pretty generally adopted with this type, and with most economical and satisfactory results. While this style of hoist has done good service in the past, and will no doubt prove satisfactory in the future under certain conditions, the fact that speed is sacrificed to power by the intermediate gearing would not recommend it for rapid or extensive workings.

When large ore-bodies have been discovered at depths ranging from 1,000 to 4,000 ft. from the surface, and it becomes necessary to remove them with the greatest expedition, the direct-acting hoist, Fig. 3, is employed. In this design, the heavy gearing of the previous type and the friction arising therefrom are avoided. The reels are placed upon the engine-shaft, and brought into action by clutches sliding on the same, and operated by clutch levers. The practice of working the cages together and balanced, by winding the ropes upon the reels in opposite directions, is followed out. A single engineer and brakeman control all the movements of the cages, the engineer landing the ascending one and the brakeman the descending one continually. The greatest leverage is secured at the moment of starting the load by winding the rope on the empty reel, and this decreases with the dead weight as the rope winds upon itself. In deep mining this dead load will vary from 3,000 to 7,000 lbs., according to circumstances. The cages sometimes attain a speed of from 4,000 to 5,000 vertical feet per minute.

When it becomes necessary to sink a small shaft or winze from a point in a drift, the rock is raised to a level of the drift by a small engine known as the baby-hoist. Fig. 4 represents a style of engine most generally used for this purpose, having two cylinders working through the same crank-shaft. The engine is made to take up as little room as possible, so that it may be placed on a car and dropped down the shaft, or moved from one part of the mine to another with dispatch. These engines are built by Beckett & McDowell, office 17 Courtlandt Street, New York; Works at Arlington, N. J.

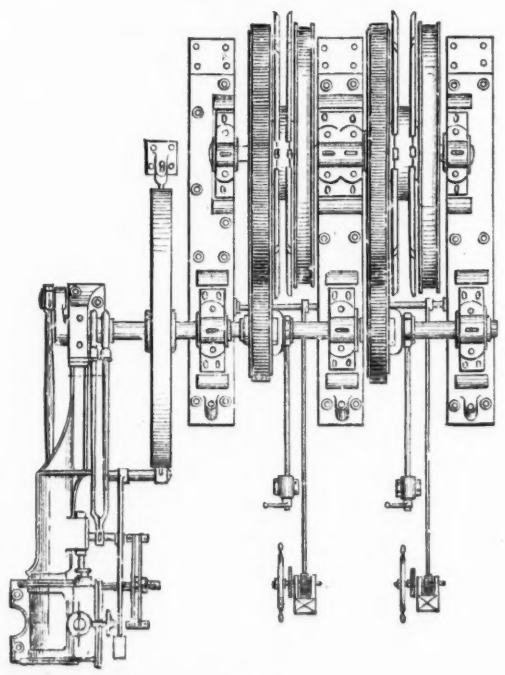


FIG. 2.

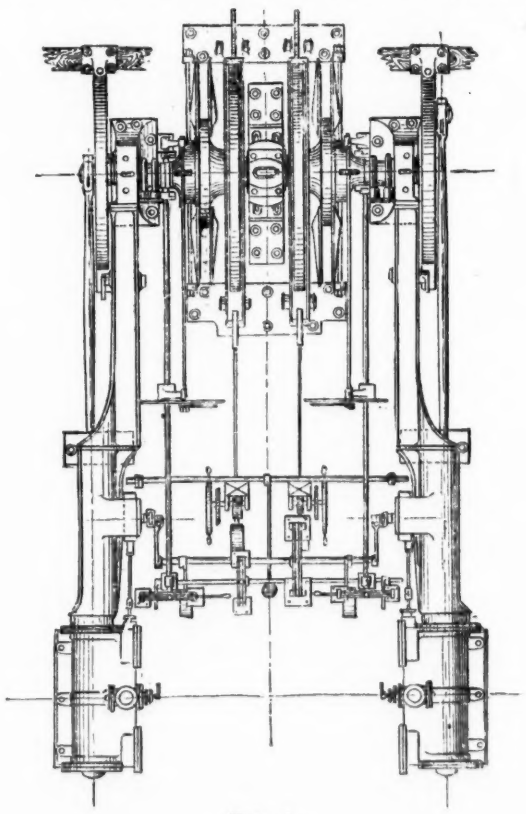


FIG. 3.

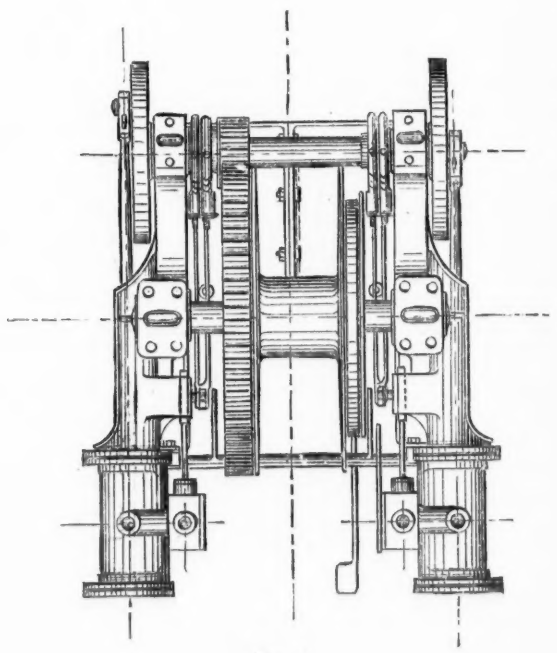


FIG. 4.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Prest.

LYCURGUS B. MOORE, Treas.

JACKSON BAILEY, Vice-Prest.

DAVIS STRONG, Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

LEWIS F. LYNE, Mechanical Engineer.

The American News Company,

Publishers' Agents, New York.

The International News Company,

(Formerly the Willmer & Rogers News Co.)

11 BOUVERIE STREET, (Fleet St.) LONDON, ENG.

Will receive subscriptions for the AMERICAN MACHINIST at 17 shillings per annum, postage prepaid.

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☞ Entered at the Post Office at New York, N. Y., as second class mail matter.

NEW YORK, MAY 29, 1880.

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British exports to this country during three months ending March 31, 1880, were: Steam engines, £1,065, against £2,001 for same time in 1879; other machinery, £103,747, against £36,884.

High and Low Engine Speeds.

The question of high speeds both of stationary and locomotive engines is one of the live topics of the day among those engaged in steam engineering. What is generally known as high speed in stationary engines is not the speed of the piston, but the number of revolutions made in a given time. Many styles of engines are constructed which have a long stroke and high piston speed that must be considered in the low-speed class, because of a low number of revolutions per minute. It is plain that where power is exerted by an engine it may, by a system of belting or gearing, cause rapid or slow speed of machinery as may be desired, but readers of the AMERICAN MACHINIST who have carefully followed Mr. Chas. T. Porter, in his able series of articles on the advantages of high-speed engines, will see the application of an important question of economy between the method of using gears, belts and pulleys to increase the speed given off by the engine, and the method of applying the engine speed directly to the work. In the highest-speed stationary engines the diameter of fly wheel has been reduced, but in the highest-speed locomotive engines the diameter of driving wheels has been increased. The new locomotive just placed on the Bound Brook line between Philadelphia and New York, which is to run the whole distance, ninety miles, in ninety minutes, has two driving wheels each 6½ feet in diameter, and therefore must make an average of 258 revolutions every minute. The ordinary locomotive with two pairs of drivers, each 5 feet diameter, would therefore have to run at much higher engine speed to attain the same speed over the rails. It is claimed that by using but one pair of drivers there is greater safety in a high rate of speed. Speed and safety are undoubtedly the two essential elements of railway travel and when both can be increased, a valuable public progress is achieved. As noted in our last issue, a 120 H. P. Porter-Allen engine is to be built for Edison's experimental works at Menlo Park, to make the extraordinary speed of 600 revolutions a minute. Visitors to this interesting establishment will then, in addition to the peculiar attractions of the electric light and electric locomotives, be treated to the novel spectacle of a fly wheel of a large engine spinning around regularly *ten times per second*. Some of the problems of fly wheels are treated in the present issue by Prof. S. W. Robinson. The relation of the fly wheel to power and speed is an important subject for consideration, and some able engineers differ materially in their theories relating to it.

Grounding Theory in Practice.

The faculty of the Stevens Institute of Technology have adopted an admirable method of grounding their students in the knowledge of actual practice, which will be so necessary to them later on. One of the professors or teachers accompanies the graduating class each year on a series of visits to a number of leading manufacturing establishments, giving the bright young "chappies," as Chordal would call them, a chance to get a taste of real shop practice. In this way several New England shops were visited recently, and some new points were scored, which our readers will hear from in the future.

A few days since we had the pleasure of accompanying the graduating class upon one of these excursions to the establishment of Henry R. Worthington, in South Brooklyn, and of witnessing the manner in which they absorbed ideas from the men who do the work. Those of our readers who recall our correspondent's recent allusion to the birth of the direct-acting steam pump, as it took shape in the mind of Mr. Worthington, when but little more than a boy, can appreciate the interest with which the young men of the Stevens Institute class listened to his graphic description of the experiences of those days, and the growth of the idea that has since become inseparably associated with his name.

The first department visited was the drawing room. The students found but few of the elegant knick-knack drawings that they were accustomed to see, but plenty of exact and figured work was submitted for their inspection, in shape for actual use in the shop. The blue-tinted, solar process drawings, now so universally adopted, though of so recent invention, by which copies for the convenience of workmen can be indefinitely multiplied, were here exhibited. The graduates next made a tour of the different shops, and were particularly interested in the details of several of the large water-works engines, which were in process of construction. The boring of the cylinders and the peculiar manner of fitting up the steam pistons attracted their special notice. Some of the boys thought this work was being done almost as well as they could have done it themselves, in the experimental shops at the Institute. Their keen and discriminating remarks were evidence that they need only continuous practice to make their theoretical knowledge available.

The castings belonging to the massive oil pumps, intended for forcing oil to tidewater through the pipe lines, and adapted to work against a head pressure of 3,500 feet, were especially investigated. These pumps are the water-works engine over again, modified to suit the novel requirements of oil transportation. The number now being constructed proves this to be a growing industry.

Some of the special tools used in the pattern shop were also scanned with interest, those used in the water meter department to produce water meters with the necessary rapidity, accuracy and low cost being also closely scrutinized.

The foundry was next visited, but too late to witness the pouring of some massive pieces, the moulds for which had been just filled. The remarks of the students upon this part of the work showed good training and good judgment. The large blowing engine used in this department is another modification of the direct-acting steam pump, pumping air, instead of water. After wandering through the various departments for a number of hours, the party returned to their starting point, the office, where their conductor, Professor Denton, pointed the moral of many of the operations they had just witnessed in some entertaining and instructive remarks. Altogether, the visit terminated with the feeling upon the part of the graduates, that they had learned many things worth remembering, and upon the part of the foremen and workmen who had explained the details of the various shops to the young fellows and listened to their comments, that they, too, had an account of knowledge gained to their credit, to show for their afternoon's work.

An Opening for Inventors.

An enterprising restaurant keeper in this city announces that chops and steaks were cooked at his establishment during the past year as follows:

Mutton Chops	31,876
Double Porter House Steaks	2,781
Single " " "	2,330
Sirloin Steaks	5,349
Tenderloin Steaks	3,942
Mutton Kidneys	5,638

On perusing the above the enormous amount of time and labor spent by the patrons of this single establishment, in getting rid of so large a quantity of fleshly edibles, suggests the idea of a machine to do the same work—an idea which should meet with favor in these days of labor-saving devices. It is often said of new devices intended to do certain work, that the old way is the best. Evidently, in view of the above statistics, eating is one of the things about which Adam knew as much as we do. Now that attention has been specifically called to this field, are our inventors ready to admit that invention is played out? It is to be hoped that the opening here indicated will be promptly filled.

In "Bits of Experience," this week, Prof. Sweet touches up the Darwinian theory of wrenches, in a suggestive manner. It is to be hoped our machine-tool builders will respond.

An Improved Form of Musical Culture.

One of our contributors, in another column, gives a hint which may serve as the keynote of a new departure in musical culture. Several steam engines, driving a number of buzz saws at varying speeds could be made to produce a "musical tone varying in pitch with the speed." It is unnecessary to explain, that, in order to produce good musical results, the saws should not saw anything except the air.

By the systematic adoption of this plan, proprietors of extensive works could utilize existing steam power to advance the musical culture of their employes and of the neighborhood in a manner beautiful to listen to. No longer, then, would the beer-vender's orchestra have charms in the evening, as those who are now its auditors would be satiated with music during the day. Nor could there be any fears of strikes or labor disturbances in such an abode of cultivated musical tastes and esthetic harmony. True, in order to carry out this plan successfully, it might be necessary to alter the speed at which some of the engines were built to run, though at some sacrifice of economy in running, but trifling obstacles of this kind would not deter any generous or high-minded employer. Besides, it is well known that many steam-engine owners care very little about steam-engine economy anyway.

For small establishments, owning but one steam engine, a combination of belts and pulleys could doubtless be arranged to run a number of saws of various sizes in connection with the engine, which would accomplish a similar result. These suggestions are offered to philanthropic employers and the public generally, with full confidence that they will be duly appreciated.

Migratory Machinists.

One of the most serious drawbacks to the pecuniary advancement and development of high skill among machinists is the apparently irresistible inclination many of them have to travel from shop to shop, and from one town to another, not remaining in any one situation long enough to reap any substantial benefit. In seasons of business depression, it may rather frequently be necessary to seek new places for employment, but in times like the present, sober, industrious and reliable men are seldom under the necessity of changing from one shop to another. A little observation will show that, in most cases, machinists who remain the longest in one shop are the most successful in accumulating means to start business on their own account, at the same time acquiring the highest skill in manipulating work. On the other hand, those who are noted for making frequent changes of base, seldom acquire anything to speak of beyond a knowledge of local geography and extensive personal acquaintances.

There are thousands of machinists who are "journeymen" in every sense of the word. These men seldom have anything to show for their work except on pay day. Their ambition seems to be to see the country and make new acquaintances. Whether they have families or live in single blessedness it is all the same with them as far as saving money is concerned. Many of them would move from Massachusetts to Ohio to get 25 cents a day more wages without the assurance of steady employment. We recognize the desirability of a machinist's taking advantage of his opportunities to better himself by a change, but many of the changes are prompted by nothing but whimsical notions. The chances for advancement and higher wages usually come from the development of extra capabilities by long and steady service in a single place. The chances of retaining a situation when a portion of the force in a shop is to be discharged are largely in favor of those who have been longest and steadiest in the service of the establishment.

Our advice to machinists is to stick to their

situations (unless they start up on their own account), upon general principles, if steady employment is afforded, and to make themselves as valuable as possible, thus complying with the conditions for receiving remunerative compensation.

(*From the Daily Journal, Lafayette, Ind.*)

The AMERICAN MACHINIST, New York, is an invaluable illustrated weekly to all iron workers, or those interested. Its manly independence is very commendable.

Thomson, Sterne & Co., Limited, The Crown Iron Works, Glasgow, Scotland, write us recently: "For some time we have been subscribers to your valuable journal, and have induced many of our friends to subscribe to it. We read it with much interest and profit."

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. M H., East New York, writes: I have set the valves on a locomotive according to instructions of Lewis F. Lyne, and find that the right side engine cuts off correctly at both ends, at 10", as intended, but the engine on left side will persist in cutting off at 9¼". What am I to do in that case? *A.*—The variations described may be caused by the links being worn, as is generally the case after an engine has been some time in service, or the links may be unequally suspended. It is evident in this case that the left hand link hangs too high. The difficulty may be remedied in any one of the following ways, viz.: Lengthen the hanger of the left hand link to lower it so as to cut off same as the right, or raise the right hand link by raising the right hand end of the tumbling shaft so that it will cut off same as the left. If a very close adjustment be desired, the difference may be equally divided by raising and lowering both ends of the tumbling shaft, which is easily accomplished upon most engines where the box is bolted upon the top of the engine frame. Please let us know which course you follow, also the result.

(2) P. W. L. Grinnell, Iowa, asks: What will weaken a fence wire the most, a blow with a hammer or a steady pressure, both leaving the same dent in the wire? *A.*—A blow with a hammer; as the effect of a blow is to instantly change the position of the molecules which compose the iron, driving them apart, and compelling them to arrange themselves differently, whereas by a steady pressure they are allowed time (so to speak) to arrange themselves more gradually without the same destructive effect.

(3) O. M. K., Jersey City, N. J., writes: In one among a number of other books which I am about to present to a young friend, is one entitled The Boston Machinist, by Fitzgerald. I find two words which I request you to explain to me. On page 48 we read "jijucs and gauges." 1. What are jijucs? *A.*—The word means "jigs," and the way it is spelled in the case referred to is probably owing to a typographical error. Jigs is the name of a special form of gauges or templates, which are used for the purpose of guiding drills for drilling any number of holes at the same position in each piece of wood. 2. On page 68 we read, "pene it straight." What is "pene?" *A.*—The word "pene" is the name of the end of a machinist's hammer opposite the face, the shape of which may be round or V shaped. To pene a piece of wood means to use the pene of the hammer instead of the face.

(4) V., Oil City, Pa., asks: Can you refer me to any instance or instances where artificial stone has been successfully used for pump foundations? There seems to be some doubt with those persons with whom I have conversed on the subject, as to whether a cement block or blocks would withstand the constant jar occasioned by the reversing of a direct acting pump working under a heavy pressure, say 1,000 pounds per square inch, as they frequently do in pumping oil in the oil country of Western Pennsylvania? *A.*—For a more severe test than you mention, we refer you to the Ordnance Department of the United States Armory at Springfield, Mass., for a report of tests of Portland cement used in the construction of artificial stone for the purpose of foundations for heavy columbiads. Concrete or Beton blocks are being used for the foundations of cotton presses in the South, in the Dock Department of New York city, also on the Washington monument. They are also used for the foundations of steam hammers and trains of rolls for rolling mills. This material is said to cost much less than other foundations, besides being much more durable. The success of artificial stone depends chiefly upon procuring, and properly handling, the best quality of Portland cement. For tests of artificial stone, also formulas for making the same, we refer you to the last edition of a book entitled Beton Agglomere and Other Artificial Stone, by General Q. A. Gillmore, U. S. A., which may be procured from any publisher of scientific books.

(5) J. A. F. Rockford, Ill., asks: I would like to know how high the vacuum should support a column of mercury when the vacuum gauge shows 26 inches? *A.*—A mercury column is considered the most accurate vacuum gauge, and both steam and vacuum gauges are often tested by a mercury column. If the gauge that you refer to is correct, and the pressure is the same upon both, the mercury column and vacuum gauge will indicate alike.

Business Specials.

40 cts. a line for each insertion under this head.

The New Pulsometer is King. "We have had one of the New Pulsometers in use for some months working day and night, and so far are much pleased with it." Robt. Fulton, Supt. Wymouth Paper Mills, Bloomfield, N. J. Office of New Pulsometer, 40 John street, N. Y.

American Watch Tool Co., Waltham, Mass. Lathes, Watch Case, and Clock-Making Machinery.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Mechanical Engineering, thorough instruction, practical and theoretical. Richards & Dole, Springfield, Mass.

For Schaffer & Budenberg's celebrated Steam Pressure, Hydraulic and Vacuum Gauges, Engine Counters, Pyrometers, Thermometers, Reducing Valves, Superior Crystal Gauge Glasses, etc., address W. Heuermann, 40 John Street, New York.

See Christiana Machine Co.'s adver., next number.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

Norris & Rutter, Mechanical Draughtsmen and Patent Solicitors, 424 Walnut Street, Philadelphia.

A new automatic valve gear for steam engines complete. Address, Ed. F. Williams, P. O. Box 148, Leadville, Colorado.

Power Shears. Stiles & Parker Press Co., Middletown, Conn.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, 65 Henry Street, Brooklyn N. Y.

James W. See, Consulting Engineer, Hamilton, Ohio.

Car Builders' Dictionary. Now ready. Assigns names to kinds and parts of railroad cars, identifying each. 800 engravings, and 490 pages. Price, postage prepaid, $2. Ten copies to one address, $17.50. Published by the *Railroad Gazette*, 73 Broadway, New York.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

To Manufacturers and others: We are prepared to build all kinds of machinery. Patent Articles a Specialty. Correspondence Invited. Mather & Newitt, Practical Machinists, Leominster, Mass.

John Fish, M. E. Air Compressors and Working Drawings a specialty. Room 23, 10 Pine St., New York.

W. Barnet Le Van, Mechanical and Consulting Engineer, 3607 Baring Street, Philadelphia, Pa.

Rare opportunity to purchase a complete set of the "Encyclopædia Britannica," 8th edition. Twenty-three books, bound in cloth, at $55. Address, J. F., care American Machinist, 96 Fulton Street, N. Y.

MANUFACTURES.

Business is "booming" with the Whittier Machine Co., Boston. They have now on hand about twenty unfilled orders for elevators, many of them requiring engines. Their elevators are gaining in popularity everywhere, especially in New York, where they have recently sold several of their best machines. They also have orders for two stationary engines for parties in Boston, and a mining engine for use on the Frazer river, Colorado, in connection with other machinery being built by them for the International Vacuum Mining and Dredging Co., of which Mr. A. C. Whittier, the treasurer of the Machine Works, is a prominent member.

Some of the Holyoke, Mass., manufacturers are putting in steam engines to enable them to run their establishments when there is low water.

A Youngstown, O., correspondent writes: Wm. Tod & Co., have a large new brick machine shop almost ready to occupy. Their conveniences for handling large work will not be surpassed by any establishment in this vicinity. Their works are now in a very prosperous condition, largely due to their able superintendent, Mr. Homer Hamilton.

A compound pumping engine of six million gallons capacity per day, has just been shipped, by the George F. Blake Manufacturing Company of New York and Boston to New Orleans, for the Auxilliary Sanitary Association of that city. The engine was built in the unusually short time of forty days, according to the terms of the contract.

The Diebold Safe and Lock Company, Canton, O., will build large additions to their already extensive works this summer.

The new process for manufacturing steel rails, which has been on trial at the Superior mill for the last few days, proves highly satisfactory, and will doubtless be continued. The old plan was to heat the steel blooms, which come in the form of blocks 7 inches square and about 4½ feet long, run them through a blooming mill, and then cut them into two pieces, each of which was afterwards heated again and passed through the rail mill, rolling into a thirty foot rail. The new plan dispenses with the preparatory heating and rolling process in the blooming mill, and instead rolls the blooms, just as they come from the market, into rails sixty feet in length, which are afterwards trimmed at the ends and cut into thirty foot pieces. This saves the labor at the blooming mill, and lessens the waste, as each piece has to be trimmed at only one end.—*Pittsburgh Commercial Gazette.*

The Guilford, Me., Woolen Mill Company have raised the pay of their help about ten per cent.

Work is being pushed as fast as possible on the new silver plating works at New Bedford, Mass. The works will have a capacity for employing 200 hands, and it is believed by the projectors that within a year the factory will be running to its full extent. Every branch of the business will be carried on upon the premises, from the preparation of the raw material to the last polish of the articles which fits them for the market.

The Telegraph Supply Company, Cleveland, O., whose works were destroyed by fire the 5th inst., are taking active measures to secure temporary premises to duplicate their ruined machinery, and to fill their numerous contracts.

The products of iron and of articles composed principally of this metal, in the various industries of Cincinnati, are of an annual value of $24,304,000 per year.

The Cherry Valley Iron Company, of Leetonia, O., have just finished laying an eight inch cast iron pipe from the boilers at the furnace to the machinery at their rolling mill, a distance of 300 yards, to convey enough steam from there to run the mill.

The Keystone Screw Company, Philadelphia, which has been idle for three years, has started up.

Armstrong & Dixon, of Philadelphia, are about erecting a large wood-pulp mill at Lock Haven.

There are now nearly one thousand men at work on the Filbert Street Elevated Railroad, Philadelphia, and the force is to be increased next week. The work will be completed in about six months.

The Pratt & Whitney Co., Hartford, are pushed with orders for machinery. They employ 540 hands, and are cramped for room and tools.

The Crystal Emery Wheel Company, capital $20,000 has been organized at Northampton, Mass. They will extend and carry on the business of manufacturing a patented emery wheel begun some months ago by C. E. Stevens.

The Union Tube Works is a new establishment at Newcastle, Lawrence Co., Pa. It has been in operation about six months, and is full of orders for boiler tubes. Their tubes are made of best charcoal iron. The works are owned by Carmichael & Emmens, 130 Cedar Street, New York, the well-known dealers in boiler-maker's supplies.

The new building for Dow's stores in Brooklyn, N. Y., is 600 feet long, 100 feet wide, and 90 feet high to the roof. There are three towers, the distance to top of towers (three in number) being 174 feet. It will hold 2,200,000 bushels of grain. There are nine fire-proof compartments. The elevator is the largest grain elevator in the world. The whole structure is to be completed in September. The architect is George B. Mallory of this city.

The Southwark Foundry and Machine Co., of Philadelphia, has made application for space in the International Exhibition to be held in New York in 1883. They offer to supply all or part of the steam-power that will be required for running the machinery on exhibition, and they ask for as large a space for their own exhibits of machinery as the Commissioners can possibly allot to them.

The Hardy Machine Shop Co., of Biddeford, Me., are making improvements in their establishment.

A stock company to build a woolen factory at Ellsworth, Me., is proposed, and over one-half the stock has been subscribed.

The Hallowell, Me., Cotton Manufacturing Company has made a second general increase of nearly ten per cent. in wages of its operatives.

A new company is forming for cotton manufacturing at White River Junction, Vt., and 60 acres of land have been given for the mill property.

A. A. Griffing has occupied the old Gautier steel works property at Lafayette, (Jer-ey City), N. J., as a manufactory of wrought iron pipes, etc.

The I. P. Morris Company, Philadelphia, have completed one of the four mortise spur wheels for the Calumet and Hecla Mining Company, of Michigan. The wheel is 22 feet 6 inches in diameter, 37½ inches face, having 180 teeth, and has a total weight of 106,000 pounds.

J. E. Gaylord is occupying his new foundry at Waterbury, Ct. The main building in dimensions is 32x70 feet, three stories high, this, however, not including the boiler, core and rolling rooms. The chipping room is 32x40 feet, and the pattern room above is the same size. The foundry room is 32x68.

The Rodney Hunt Machine Works of Orange, Mass., have just finished a 25x40 feet addition.

The Orange Iron Company, Orange, Mass., are building a 30x40 feet brick addition to their foundry, which will make room for six more furnaces.

The Greenfield, Mass., Co-operative Cutlery Company will soon have their machinery in running order in their new quarters. A switch track will connect the company's land with the Troy and Greenfield road.

The Warren Cotton Company has begun excavating for the foundations of their new mill at West Warren, Mass., which is to be a two-story structure, and will cover about a half acre of ground.

Ground has been broken at the site of the two new blast furnaces which the Eureka Iron Company propose to build near Birmingham, Ala.

The large mill of the Birmingham, Ala., Rolling Mill Company is rapidly nearing completion, with very good prospects of commencing work by the latter part of June.

The first attempt to manufacture woolen material by machinery in India is to be made by the Egerton Woolen company in the Punjaub.

Says the Philadelphia *North American:* When we are told that the tonnage carried over the Pennsylvania railroad main line, between Philadelphia and Pittsburg annually, is fully as great as that of the foreign commerce of the republic, the statement naturally excites wonder and seems incredible. Yet this railway, between the two points named, is but a comparatively small part of the vast American railroad system, the trade of which is in all respect, truly amazing.

The owners of the Indianapolis Rail Roling Mill established a steel rail mill this season on a capital of $750,000, with a capacity of 250 tons per day.

The Deakin Bessemer Steel and Iron Co. have been organized in St. Louis to introduce what is called the Deakin-Block process for welding Bessemer steel. It is claimed that rail ends, steel cuttings, etc., can be utilized by this process.

Machinists' and Engineers' Supplies.

NEW YORK, May 13th, 1880.

Dealers in supplies generally this week report more activity, but the manufacturers still consider the market dull. This state of affairs will probably continue until the stock now in the hands of dealers is materially reduced.

A strong effort is being made to hold up prices, but unless iron should advance very soon, the prices of manufactured iron goods will necessarily be reduced.

There is a large demand for machine screw taps. The dies to accompany these taps are also in good demand.

Machine screws are still hard to procure.

The prices of Bolts and Nuts have declined a little, and are this week quoted as follows; Nuts, 6½c. off, Washers, 6c., Machine Bolts, Lag Screws and Bolt ends, 55 % discount.

H. Prentiss & Company, 14 Dey Street, New York, have just issued a new illustrated Catalogue and Price List of Machinists' Tools and Supplies. It contains 100 pages and exhibits some new tools.

Iron Review.

NEW YORK, May 13, 1880.

There is nothing attractive about the iron market this week. No. 1 foundry has declined to $25, with other grades in proportion. It is hardly probable that it can decline much more. Scotch pig seems to be a little firmer at $20 for Eglington, $23 for Coltness and $21½ to $22½ for Glengarnock, Summerlee and Gartscherree.

There is a fair demand for manufactured iron this week at low prices. The feeling among dealers is that the market cannot remain in favor of the buyer much longer.

Pierson & Co., 24 Broadway. N. Y., under date of May 13th, 1880, quote prices out of store as follows, although they say prices are nominal:

Iron Rails, $57½ to $60, according to weight; Fish Plates, 3c. per lb.; Railway Spikes, 2½c.; Bolts and Nuts, 4c.; Common Bar Iron, nominal, 2 7-10c., basis from store; Refined do. 3c., basis; Ulster, 4 2-10c. basis; Machinery Steel, 7c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 7c.; Sheet Iron, 4c., basis; Angle Iron, 4c.; Tee Iron, 4 5-10c.; Band Iron, 3 7-10c; Hoop Iron, 3 7-10c., and up according to size; Horse Shoe Iron, 4c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10¼c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Maker's Supplies as follows:

Flange, 5c. to 5¼c.; C. H. No. 1 Shell, 4c.; Tank, 3¼c.; C. No. 1, 3¼c.; Boiler Tubes, 45% discount from list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of May 13th, 1880:

No important changes to report in Metals.

Pig Tin has declined in London to £77.10/—and in Singapore to $23¾. This market nominally; Banca Tin, 22c.; Malacca & Straits, 18c.; Billiton, 17½c.; Australian and English Refined, 17¾c.; "Lamb & Flag," 18¼c.; Pig Lead, 5½c. to 5¼c.; Antimony, 21½c. to 22c. for Cookson; 18c. to 18½c. for Hallett & Johnson; Spelter, 6c. for Domestic, 6¼c. for Foreign; Ingot Copper, 20¼c. to 20½c.; Nickel, $1.25; No. 1 Solder, 10¾c.; "half and half, 12¾c.

WANTED.

Wanted—Ten first-class moulders. Address Holyoke Machine Co., Holyoke, Mass.

Machinists Wanted.—Address. Watertown Steam Engine Co., Watertown, New York.

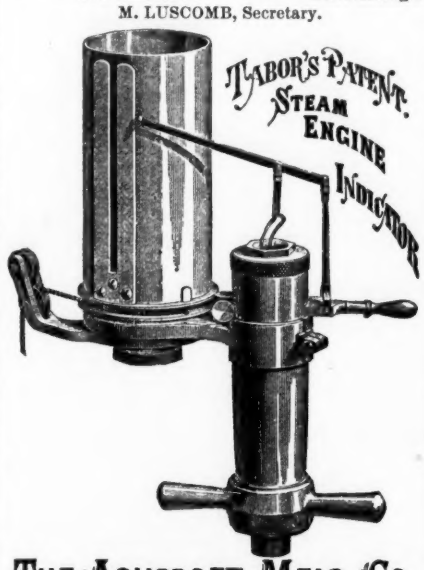
Wanted.—A traveling salesman familiar with steam machinery. Kelly & Ludwig, 720 Filbert St., Phila. Pa.

Wanted.—Twenty good machinists and ten good moulders. H. B. SMITH MACHINE CO., Smithville, Burlington County, N. J.

Machinists Wanted.—Good Lathe and Planer hands can find steady employment and good pay. None need write us unless willing to name amount per diem wanted. Hendey Machine Co., Wolcottville, Conn.

A Swede, 25 years old, is desirous of obtaining a position as draughtsman, prefers Marine Engine business, is a graduate from technical High school, has served an apprenticeship in his native country and as Machinist. Address, "America," P. O. Box 166 Holyoke, Mass.

E. H. ASHCROFT, Pres. and Treas. CHAS. A. MOORE, Gen'l Manager. M. LUSCOMB, Secretary.



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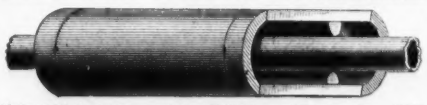
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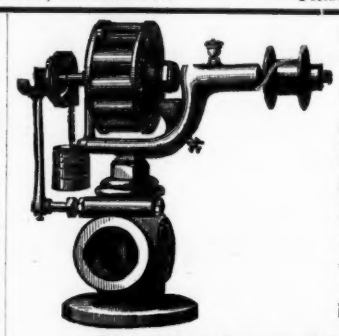
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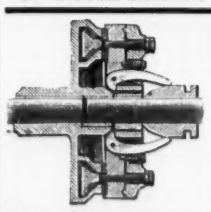
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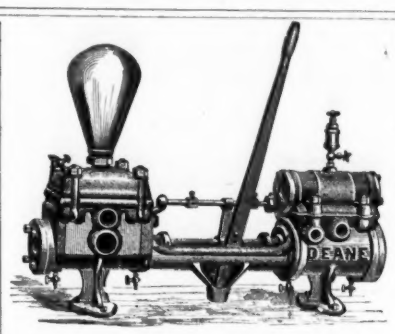

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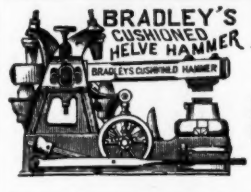

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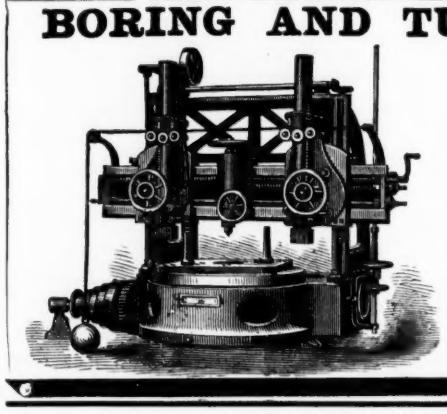

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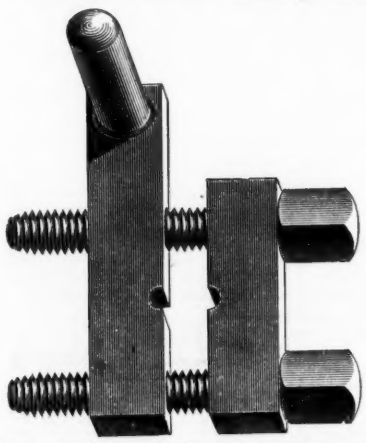

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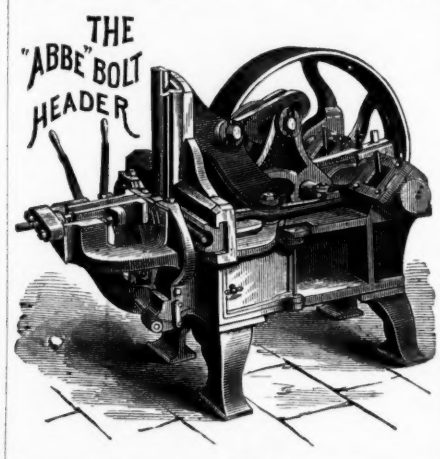

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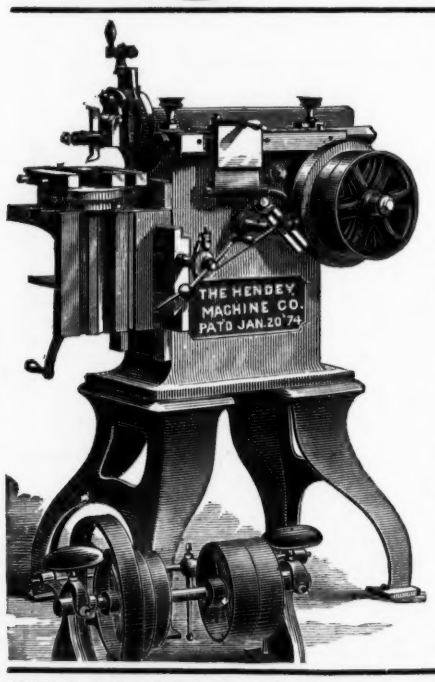

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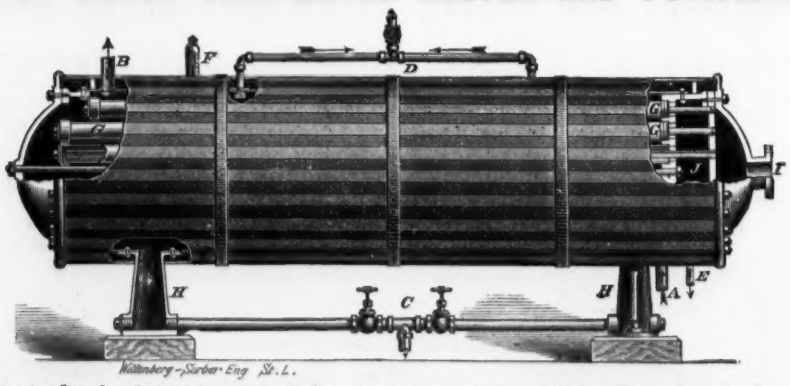

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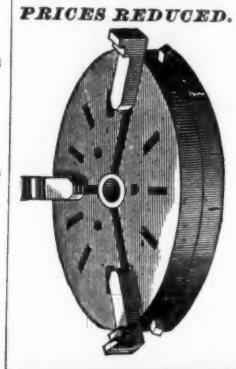

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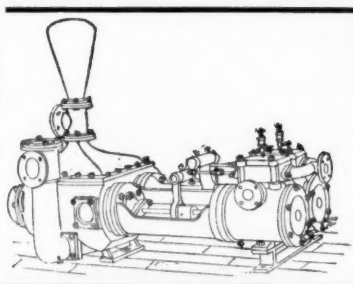

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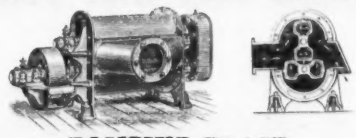

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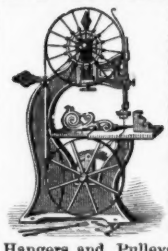

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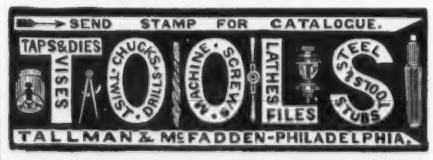

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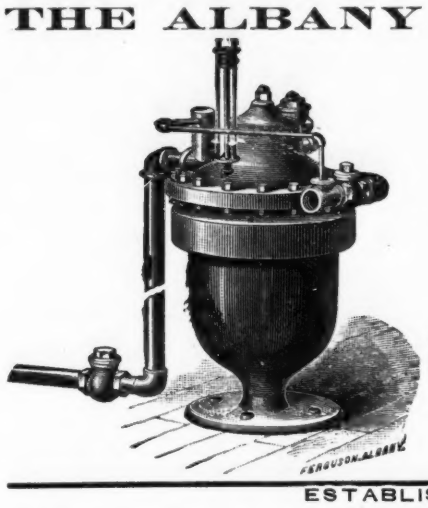

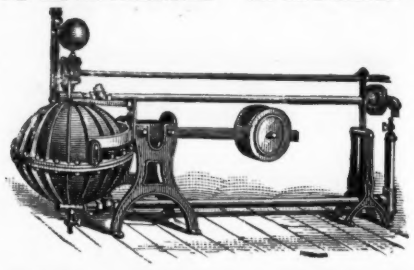

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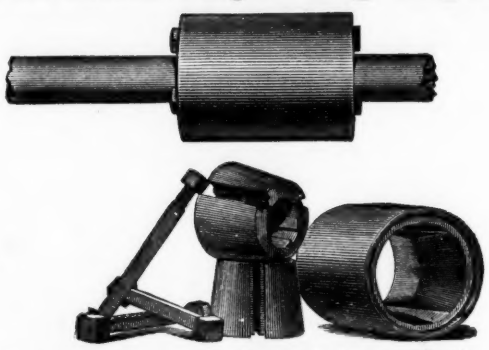

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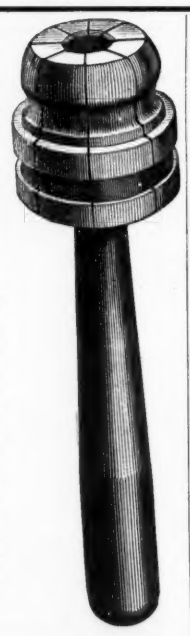

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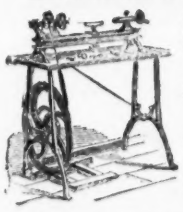

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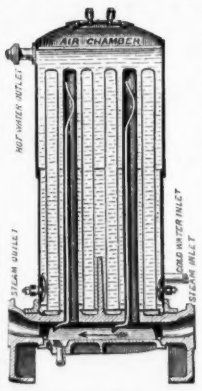

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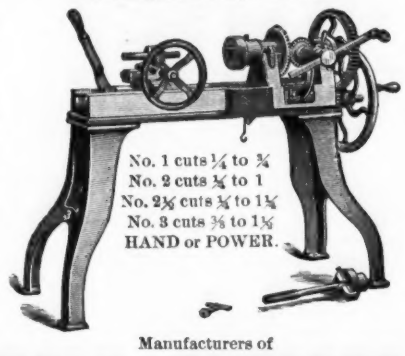

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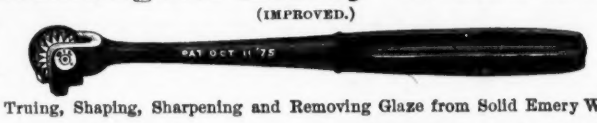

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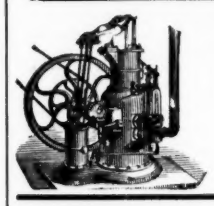

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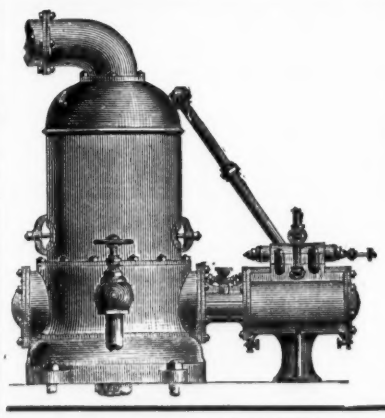

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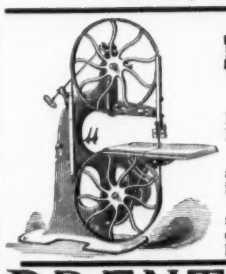

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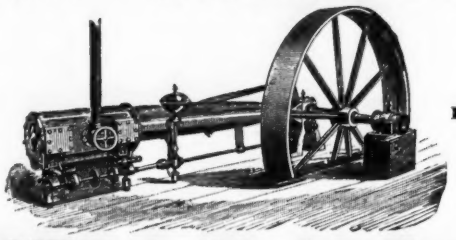

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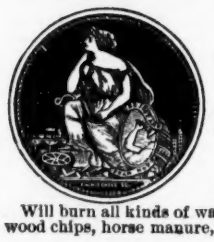

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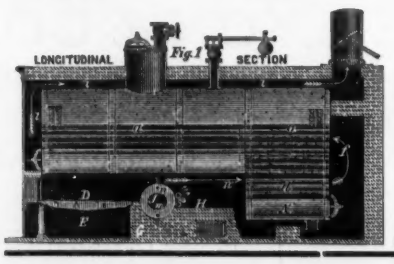

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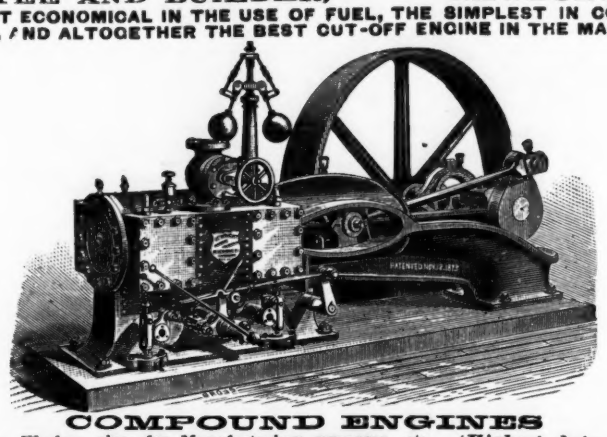

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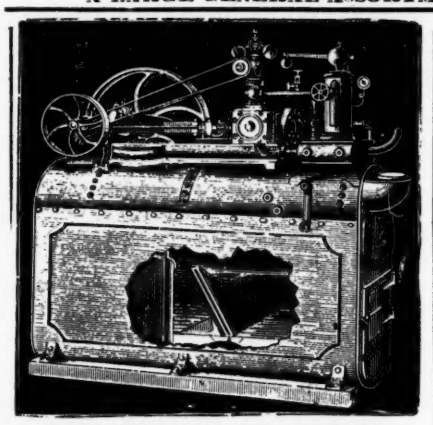

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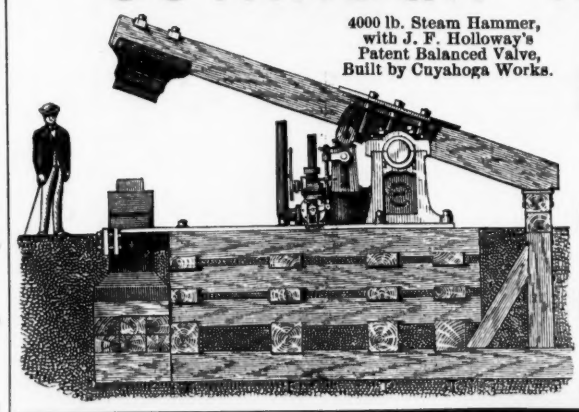

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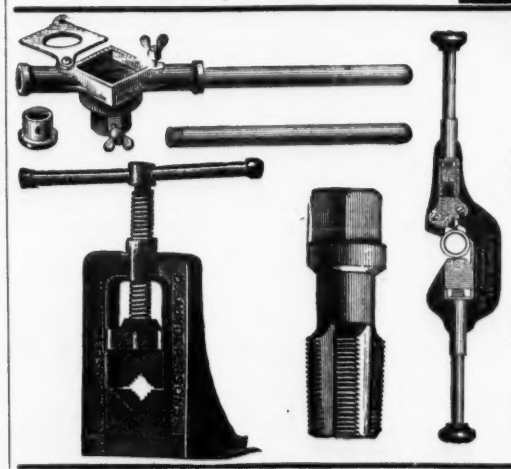

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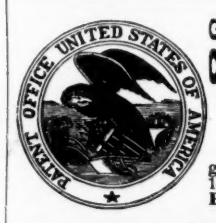

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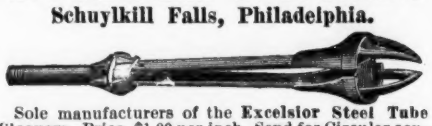

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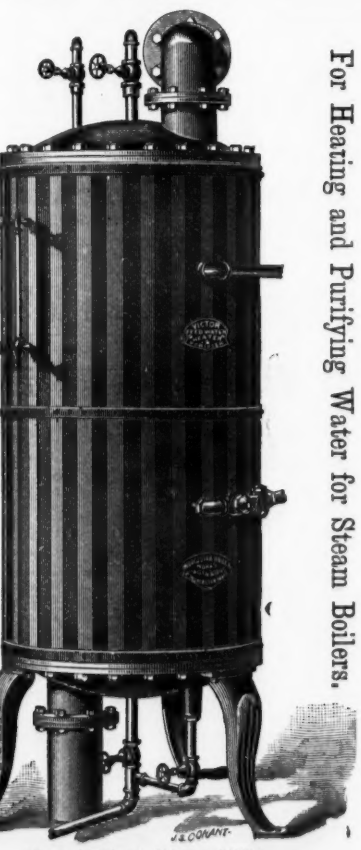

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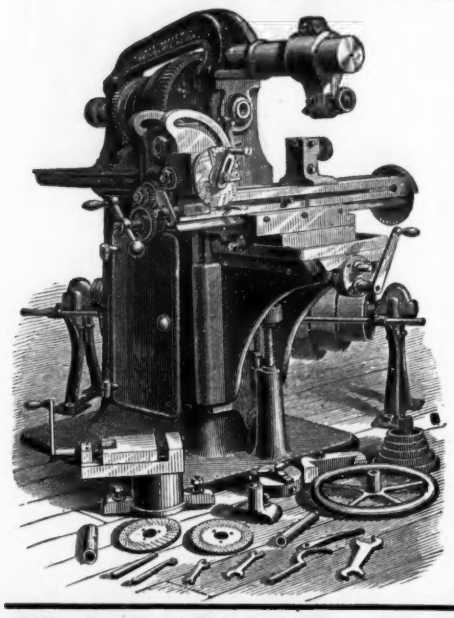

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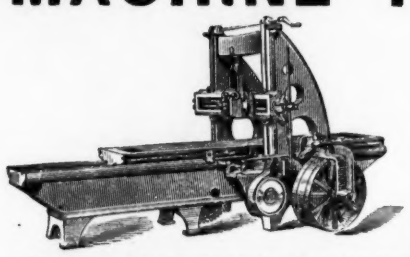

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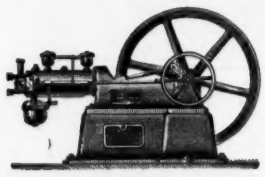

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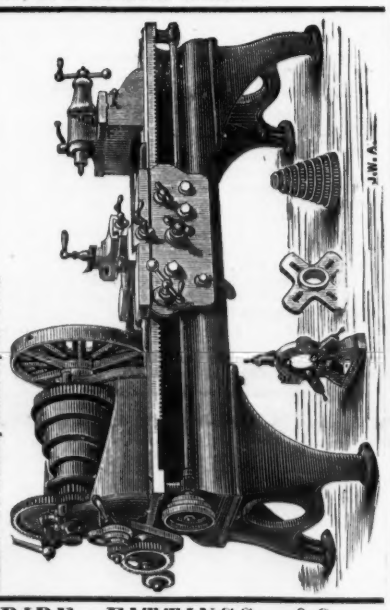

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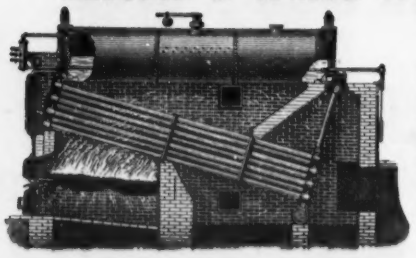

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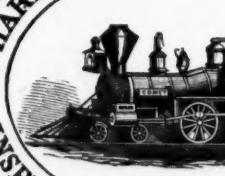

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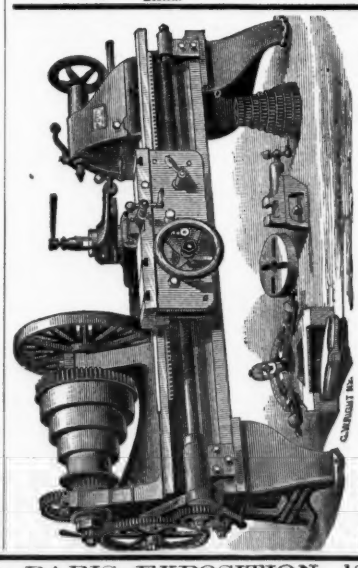

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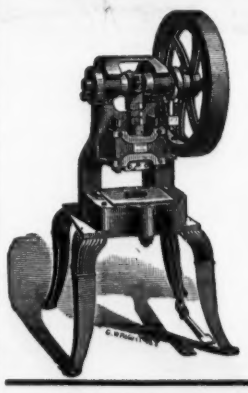

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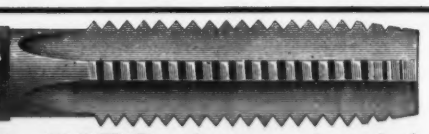

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